

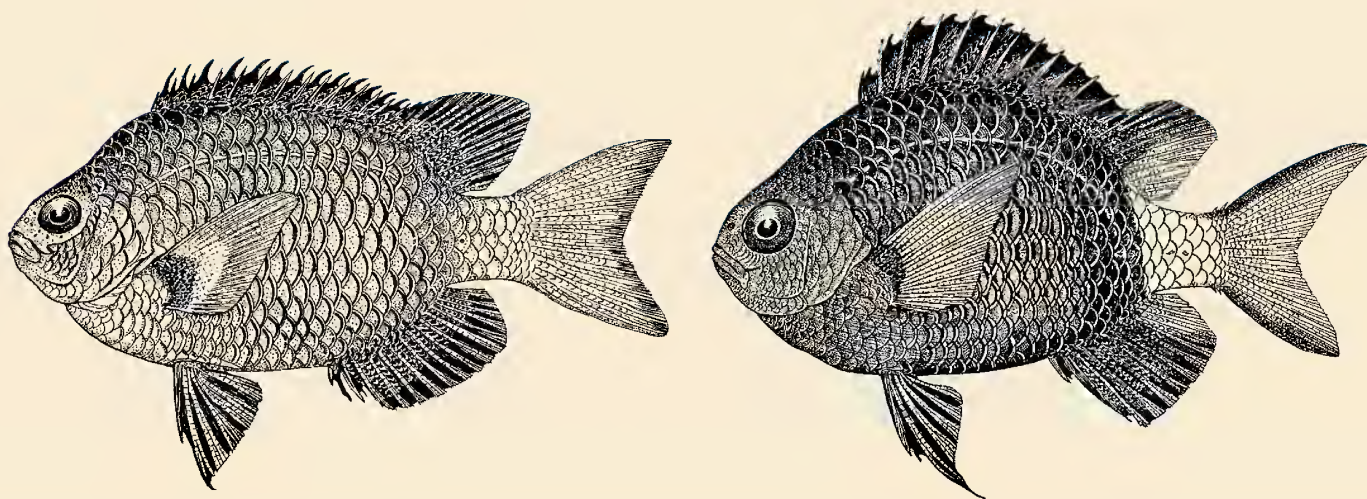
RECORDS OF THE AUSTRALIAN MUSEUM

Volume 60

Numbers 2 & 3

1 October 2008

Syllinae (Polychaeta: Syllidae) from Australia. Part 1. Genera <i>Branchiosyllis</i> , <i>Eurysyllis</i> , <i>Karroonsyllis</i> , <i>Parasphaerosyllis</i> , <i>Plakosyllis</i> , <i>Rhopalosyllis</i> , <i>Tetrapalpia</i> n.gen., and <i>Xenosyllis</i> GUILLERMO SAN MARTÍN, PAT HUTCHINGS AND MARÍA TERESA AGUADO	119
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Volume 60 Numbers 2 & 3

Published 1 October 2008

Price: AU\$50.00

Printed by RodenPrint Pty Ltd, Sydney

ISSN 0067-1975

The Australian Museum is a statutory authority of,
and principally funded by, the NSW State Government.

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Syllinae (Polychaeta: Syllidae) from Australia. Part 1.

Genera *Branchiosyllis*, *Eurysyllis*, *Karroonsyllis*, *Parasphaerosyllis*, *Plakosyllis*, *Rhopalosyllis*, *Tetrapalpia* n.gen., and *Xenosyllis*

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ABSTRACT. Large collections of Syllidae (Polychaeta) from around Australia, housed at the Australian Museum (Sydney), have been examined and identified. Australian material from the Hamburgische Zoologische Museum der Universität, Hamburg, Germany was also examined, as well as some specimens lodged in other museums. All known Australian species of the subfamily Syllinae (Syllidae) belonging to the genera *Branchiosyllis* Ehlers, 1887 (9 species); *Eurysyllis* Ehlers, 1864 (1 species); *Karroonsyllis* San Martín & López, 2003 (1 species); *Parasphaerosyllis* Monro, 1937 (1 species); *Plakosyllis* Hartmann-Schröder, 1956 (1 species); *Rhopalosyllis* Augener, 1913 (1 species), *Tetrapalpia* n.gen. (1 species), and *Xenosyllis* Marion & Bobretzky, 1875 (2 species), are described and figured. Some were examined using the Scanning Electron Microscope to illustrate characters and methods of reproduction in this subfamily. Since there are numerous genera and species of Syllinae, the results will be presented in a series of several papers treating different genera. Keys to genera of Australian Syllinae will be provided in the final paper. Keys to species level are provided for genera having more than one Australian representative. Six new species are described: *Branchiosyllis baringabooreen*, *B. orbiniiformis*, *B. carmenroldanae*, *B. thylacine*, *Xenosyllis moloch*, and *X. scabroides*. A new genus, *Tetrapalpia* is described for the species *Opisthosyllis dorsoaciculata*. The genus *Xenosyllis* is described for the first time from Australia, as well as *Branchiosyllis oculata* Ehlers, 1887, and *B. maculata* (Imajima, 1966). A discussion of the reproduction and systematics of the subfamily is given.

SAN MARTÍN, GUILLERMO, PAT HUTCHINGS & MARÍA TERESA AGUADO, 2008. Syllinae (Polychaeta: Syllidae) from Australia. Part 1. Genera *Branchiosyllis*, *Eurysyllis*, *Karroonsyllis*, *Parasphaerosyllis*, *Plakosyllis*, *Rhopalosyllis*, *Tetrapalpia* n.gen., and *Xenosyllis*. *Records of the Australian Museum* 60(2): 119–160.

This is the third monograph contributing to our study of the Australian Syllidae, based on the large collections housed in the Australian Museum from all around Australia, but primarily from Western Australia and New South Wales, and

revision of material collected and described by Hartmann-Schröder in her series of papers on Australian polychaetes (1979–1991). This paper also summarizes published material of San Martín (2002, 2005), San Martín & López (2003), San

* author for correspondence

Martín & Hutchings (2006), and San Martín *et al.* (2007). A general introduction to the family Syllidae in Australian waters is given by San Martín (2005) in his revision of the subfamily Exogoninae. In this paper, all species belonging to the Syllinae genera *Branchiosyllis*, *Eurysyllis*, *Karroonsyllis*, *Parasphaerosyllis*, *Plakosyllis*, *Rhopalosyllis*, *Tetrapalpia* n.gen., and *Xenosyllis*, are described and figured, and keys to species are provided. Comments are given on those genera of Syllinae not treated in this paper. Subsequent papers will deal with other genera of Syllinae and Autolytinae.

The subfamily Syllinae is attributed to Grube (1850), who erected the family Syllidae. Langerhans (1879), used the term Tribe Syllideae, for the genera *Syllis* Lamarck, 1818; *Opisthosyllis* Langerhans, 1879; *Pronosyllis* (sic for *Pionosyllis* Malmgren, 1867), *Opisthodonta* Langerhans, 1879; *Xenosyllis* Marion & Bobretzky, 1875; *Syllides* Örsted, 1845; *Eusyllis* Malmgren, 1867; *Odontosyllis* Claparède, 1864; and *Amblyosyllis* Grube, 1857. Subsequently, Malaquin (1893) removed *Pionosyllis*, *Opisthodonta*, *Syllides*, *Eusyllis*, *Odontosyllis*, and *Amblyosyllis* and placed them in the subfamily Eusyllinae. Fauvel (1923) included *Eurysyllis* in the Syllinae, and Perkins (1981) proposed the same for *Plakosyllis*, and described *Dentatisyllis* Perkins, 1981. Fauchald (1977) included additional genera in the subfamily Syllinae: *Haplosyllides* Augener, 1922; *Branchiosyllis*, *Parapterosyllis* Hartmann-Schröder, 1960; *Pseudosyllides* Augener, 1927; *Geminosyllis* Imajima, 1966; *Haplosyllis* Langerhans, 1879; *Parasphaerosyllis*, *Paratyposyllis* Hartmann-Schröder, 1960; *Ehlersia* Langerhans, 1881; and *Typosyllis* Langerhans, 1879. San Martín (1984, 1992, 2003) considered *Typosyllis* and *Ehlersia* as synonymies of *Syllis*; and in (2003), proposed the name *Inermosyllis* to replace *Pseudosyllides*, as it is a homonym for *Pseudosyllides* Czerniavsky, 1882.

Recently, Glasby & Watson (2001) described another genus of Syllinae: *Alcyonosyllis*, and earlier, Hartmann-Schröder (1990) described another new genus for Australia: *Parahaplosyllis*. San Martín & López (2003) described *Karroonsyllis* from Western Australia. Currently, 18 genera are considered as belonging to the subfamily Syllinae: *Alcyonosyllis*, *Branchiosyllis*, *Dentatisyllis*, *Eurysyllis*, *Geminosyllis*, *Haplosyllides*, *Haplosyllis*, *Inermosyllis*, *Karroonsyllis*, *Nuchalosyllis*, *Opisthosyllis*, *Parahaplosyllis*, *Parasphaerosyllis*, *Plakosyllis*, *Syllis*, *Trypanosyllis*, and *Xenosyllis*. *Rhopalosyllis* was previously considered as belonging to the Eusyllinae, but is considered here as belonging to Syllinae, as it has articulated cirri and reproduces by sexual stolons. *Parapterosyllis*, *Paratyposyllis*, and *Reductotyposyllis* are not considered as valid genera, based on studies of the type material by the first author. *Parapterosyllis sexoculata* (HZM P-14728) is a damaged specimen of *Trypanosyllis*; *Paratyposyllis paucicirrata* (HZM P-14729) are two recently metamorphosed specimens of *Syllis*; *Reductotyposyllis atentaculocirrata* (HZM P-14768) is a regenerating posterior end of a species of *Syllis*.

In this paper, we erect a new genus, *Tetrapalpia* for a single species, *Opisthosyllis dorsoaciculata* Hartmann-Schröder, 1991, which has a unique character distinguishing it from all other genera, namely palps divided longitudinally by a furrow, appearing as having four palps instead of the typical two. Currently 12 of the genera regarded as belonging to the subfamily Syllinae are known to occur in Australia.

Additional new genera from Australia will be described in subsequent papers.

The subfamily Syllinae is more or less homogeneous, characterized by having articulated appendages, free or partially fused palps, and undergoing schizogamic scissiparous reproduction; but some genera have morphological characters more typical of the subfamily Eusyllinae, such as the presence of smooth, unarticulated antennae, tentacular and dorsal cirri (e.g., *Alcyonosyllis*, *Haplosyllides*) or of the Exogoninae, such as having fused palps and a single pair of tentacular cirri (*Karroonsyllis*). While these latter genera have morphological characters characteristic of other subfamilies they undergo schizogamic scissiparous reproduction which, probably is the major character for defining the subfamily Syllinae (Garwood, 1991; San Martín, 1984, 2003; Glasby, 2000). There are different kinds of stolons; for description of these see San Martín, 2003. For some genera their method of reproduction is unknown and therefore their subfamilial affiliation is unclear, and highlights the need for a major revision of the family Syllidae.

Like most syllids, Syllinae are dorsally arched, convex, ventrally flat or even concave, but some genera (*Trypanosyllis*, *Eurysyllis*, *Plakosyllis*, *Rhopalosyllis*, *Xenosyllis*, and some species of *Branchiosyllis*) have dorsoventrally flattened, ribbon-like bodies, and one species of *Branchiosyllis* described in this paper, is laterally compressed. Size range of the subfamily Syllinae varies from medium to large (see San Martín & Hutchings, 2006, for definitions of these terms). They occur in a similar range of habitats as members of other subfamilies, but are especially common on hard bottoms (see San Martín, 2003). Typically they are less fragile than the Eusyllinae, and complete, well preserved specimens necessary for detailed studies are common in museum collections. Some Syllinae are brightly coloured, with dorsal stripes. Some species of *Branchiosyllis*, and *Opisthosyllis* and all the known species of *Rhopalosyllis* and *Xenosyllis* have numerous dorsal and sometimes ventral epidermal papillae. The palps are fused, partially fused, or free from each other. Syllinae have three antennae that are typically long, extending beyond the palps. Four lensed eyes, and sometimes two additional eyespots are present, although especially the latter, may fade with time on preserved material. The peristomium has two pairs of tentacular cirri (except in a few genera in which only a single pair is present); the fronto-dorsal peristomial margin may be modified to form an occipital flap in some species of *Opisthosyllis*. Nuchal organs consist of two dorsolateral, densely ciliated grooves situated between the prostomium and peristomium. The pharynx is straight, typically with a conical tooth which is located either on the anterior margin, behind the anterior rim, or in the middle or posterior part of the pharynx; *Inermosyllis* San Martín, 2003, lacks a pharyngeal tooth, and *Trypanosyllis*, *Geminosyllis* Imajima, 1966, *Eurysyllis*, and some others, have a crown of teeth, referred to as a trepan, surrounding the pharyngeal opening.

Parapodia are uniramous, with dorsal and ventral cirri, present on all segments. Dorsal cirri typically are long, filiform, articulated. Members of the Syllinae reproduce by schizogamous scissiparity (Garwood, 1991; Franke, 1999; San Martín, 2003), developing sexual stolons with capillary notochaetae used for swimming on all segments except the first one, which remains uniramous.

Material and methods

The material examined was mainly from the collections in the Australian Museum (AM), and was collected by many including: N. Coleman, G. Wilson, J. K. Lowry, R. T. Springthorpe, H. E. Stoddart, P. A. Hutchings, A. Murray, T. J. Ward, P. C. Young, and A. Jones. Australian material housed in the Zoologisches Museum of Hamburg (HZM), collected and identified by Hartmann-Schröder, has been re-examined and compared with Australian Museum material. The specimens are preserved in 70% ethanol after fixation in formalin. Examinations were made using a compound microscope with interference contrast optics (Nomarsky). Drawings were made using a camera lucida drawing tube. Scanning Electron Microscope observations and photographs were made at the SIDI (Servicio Interdepartamental de Investigación) of the Universidad Autónoma de Madrid, Spain.

The width of specimens, excluding parapodia and chaetae, was measured at the proventricular level.

Information about aboriginal words for the names of several new taxa was obtained from Endacott (1973). The order of descriptions, both for genera and for species in each genus, is alphabetical.

Some structures difficult to see under light microscope such as eyespots, are described only when they were observed on the specimens. While nuchal organs are present on all syllids, they are not always clearly visible, species descriptions reflect this.

Specimen size categories given in the text are: small (< 5 mm in length), medium (5–10 mm in length) and large (> 10 mm in length). Typically in syllids the length of chaetal blades within a fascicle decreases from dorsal to ventral (dorsoventral gradation); and also the shape and length of the chaetae may vary along the body, and therefore all descriptions include this information.

The *Material examined* section lists material in an anticlockwise direction around Australia, beginning from Western Australia.

The following abbreviations are used:

AM	Australian Museum, Sydney
ZMH	Zoologisches Museum für Hamburg
MNCN	Museo Nacional de Ciencias Naturales de Madrid
ZMB	Naturhistorisches Forschungsinstitut Museum für Naturkunde, Zentralinstitut der Humboldt-Universität zu Berlin
MNHN	Museum national d'Histoire naturelle, Paris

Genus *Branchiosyllis* Ehlers, 1887

Branchiosyllis Ehlers, 1887: 148.

Diagnosis. Body of medium to large size, some species cylindrical, others dorsoventrally flattened, or laterally compressed, with numerous segments. Prostomium with 4 eyes, and sometimes 2 eyespots, 3 antennae and 2 palps. Palps fused at bases. Two pairs of tentacular cirri. Antennae, tentacular, anal and dorsal cirri distinctly articulated. Parapodia with branchiae or digitiform lobes on some species, absent on most species. Compound chaetae falcigers; blades of some or all chaetae rotated 180°, claw-shaped. Capillary simple chaetae absent. Pharynx similar in length or longer than proventricle, with an anterior tooth, surrounded by crown of about 10 soft papillae. Two anal cirri.

Type species. *Branchiosyllis oculata* Ehlers, 1887, by monotypy.

Remarks. *Branchiosyllis* on the basis of the few previously described species, was previously divided into two groups. One group, including *B. oculata*, *B. pacifica* Rioja, 1941, and *B. lamellifera* Verrill, 1900, is characterized by having dorsoventrally flattened bodies and branchiae, all chaetae claw-shaped falcigers (rotated 180°), and lacking normal falcigers (not rotated) (see Ehlers, 1887; Rioja, 1941; and Verrill, 1900). The other group has cylindrical bodies, lack branchiae, and both normal falcigers and claw-shaped falcigers are present from midbody segments onwards. This latter group consists of the *B. exilis* complex; and *B. lorenae* San Martín & Bone, 1999 and we have added the following species: *Syllis fuscoturata* Monroe, 1933, and *Syllis (Typosyllis) plessisi* Rullier, 1972 (see Monroe, 1933; Rullier, 1972), both considered as synonyms of *B. exilis* (Licher, 1999), as well as *Typosyllis bathialis* Kirkegaard, 1995; *Typosyllis salina* Hartmann-Schröder, 1959 (questionable); *T. maculata* Imajima, 1966; and *Syllis (Typosyllis) verruculosa* Augener, 1913 (see Kirkegaard, 1995; Hartmann-Schröder, 1959; Imajima, 1966; Augener, 1913), transferred by Licher (1999) to *Branchiosyllis*. *Branchiosyllis abbranchiata* Hartmann-Schröder, 1965, from Samoa/Tutuila, is a small specimen (see Hartmann-Schröder, 1965), probably a juvenile which may represent *B. exilis*; based on a re-examination of the type specimen (HZM P-14574).

One species, *B. diazi* Rioja, 1958, has an intermediate position between the two groups, in that it has branchiae, dorsoventrally flattened body as in the first group, and both normal falcigers and claw-shaped falcigers in posterior parapodia as in the second group as does *B. baringabooreen* n.sp. Specimens of *B. roldanae* n.sp., have few chaetae present and are attributed to *Branchiosyllis* based on the chaetal structure of these few chaetae. This study reveals that the two groups of *Branchiosyllis* are not well defined and relationships within the genus must be re-evaluated.

The species *Syllis (Typosyllis) cirropunctata* is transferred to the genus *Branchiosyllis* because of the presence of the compound chaetae characteristic of the genus, and it is close to *B. exilis*.

Key to Australian species of *Branchiosyllis*

- 1 Body laterally compressed *B. orbiniiformis* n.sp.
 — Body dorsoventrally flattened or cylindrical 2
- 2 Body dorsoventrally flattened 3
 — Body cylindrical 4
- 3 Body uniformly dark or with transversal dark bands (sometimes without colour pattern). All chaetae claw-shaped falcigers. Dome-shaped branchiae on parapodial lobes *B. oculata*
 — Body with distinctive black and white pigmentation. Chaetal fascicle with some normal falcigers and claw-shaped falcigers. Branchiae absent *B. baringabooreen* n.sp.
- 4 Body papillated *B. verruculosa*
 — Body smooth 5
- 5 Large specimens with few chaetae (not broken). Dorsal band of segmental glands, opening with minute pores (SEM) *B. carmenroldanae* n.sp.
 — Parapodia with numerous chaetae on all individuals. Dorsal bands of segmental glands absent 6
- 6 Segments with distinct complete transverse black band *B. thylacine* n.sp.
 — Without colour pattern or, if present, forming incomplete bands 7
- 7 Without distinct colour pattern *B. exilis*
 — With colour pattern, especially distinct dark spots on some articles of dorsal cirri 8
- 8 Compound chaetae of posterior parapodia, all claw-shaped falcigers (Fig. 6E–F), shafts angular, with subdistal spurs *B. cirropunctata* n.comb.
 — Compound chaetae of posterior parapodia, of 2 kinds, claw-shaped and unmodified falcigers (Fig. 9F), shafts angular without subdistal spurs *Branchiosyllis maculata*

Branchiosyllis baringabooreen n.sp.

Figs 1A–D, 2A–E

Material examined. HOLOTYPE (AM W30088) **Western Australia:** Bernouli Island, 15°00'S 124°47'E, sandy substrate with coral rubble, intertidal, coll. P.A. Hutchings, 12 July 1988. PARATYPES 1 (AM W26511) W side of Cassini Island, 13°57'S 125°37'E, coralline algae and rubble, low tide, coll. P.A. Hutchings, 18 July 1988; 1 on SEM stub (AM W29247) Condillac Island, 14°06'S 125°33'E, sand, coral rubble, 11 m, coll. P.A. Hutchings, 15 July 1988; 1 (AM W30089) Bernouli Island, 15°00'S 124°47'E, coll. P.A. Hutchings, 12 July 1988; 2 (AM W30090) Reef S of Lucas Island, Brunswick Bay, 15°16'S 124°29'E, dead coral with *Sargassum* with heavy silt loading, 2 m, coll. P.A. Hutchings, 24 July 1988.

Description. Body ovate, large, strongly dorsoventrally flattened (Figs 1A, 2A); prostomium and peristomium slightly pigmented, chaetiger 1 more pigmented than chaetigers 2 and 3, subsequent segments alternating between one strongly pigmented with dark nearly black dorsal cirri, followed by a less pigmented segment and dorsal cirri (Fig. 1A). One dorsal oval spot on dorsum of each segment, except for those most anterior. Holotype 12 mm long, 1.5 mm maximum width, with 75 chaetigers; largest specimen 16 mm long, 1.8 mm wide, with 95 chaetigers. Prostomium relatively small, ovate (Figs 1A, 2A); 4 small eyes in open trapezoidal arrangement, almost vertically aligned. Antennae inserted near anterior margin of prostomium, all similar in length, slightly shorter than combined length of prosto-

mium and palps, with about 10 articles. Palps large, slightly ventrally folded. Nuchal organs not observed. Peristomium slightly shorter than subsequent segments; dorsal tentacular cirri longer than antennae, with about 13 articles; ventral tentacular cirri similar in length to antennae, with 7–8 articles. Following segments gradually increasing in width (Figs 1A, 2A) until midbody, then becoming progressively narrower posteriorly. Cirrophores well developed (Figs 1B, 2B), with single basal black spot. Dorsal cirri spindle-shaped, with distinct, rectangular articles, distal one conical; alternating irregularly; long dorsal cirri, with 16–18 articles, and short cirri, 10–11 articles; all dorsal cirri shorter than body width. Parapodia blunt, without branchiae (Fig. 1B). Ventral cirri digitiform, shorter than parapodial lobes. Typically 4 compound chaetae per parapodium, all similar (Fig. 1C), 3 dorsal ones with claw-shaped, blades rotated 180°, 47–50 µm long, and one ventral with strongly hooked blade, about 33 µm long; some parapodia with only 2–4 falcigers, all claw-shaped (Figs 2C–E); all blades smooth and unidentate; shafts thick. Parapodia with 2 straight, slender aciculae, one distally pointed, other with slightly oblique tip (Fig. 1D). Pharynx relatively slender, through 7–8 segments; pharyngeal tooth small, anteriorly located (Fig. 1A). Proventricle proportionally slender, through 5–6 segments, with 33–35 muscle cell rows. Pygidium small, with 2 anal cirri similar to dorsal cirri but shorter. Some specimens with acephalous sexual stolons.

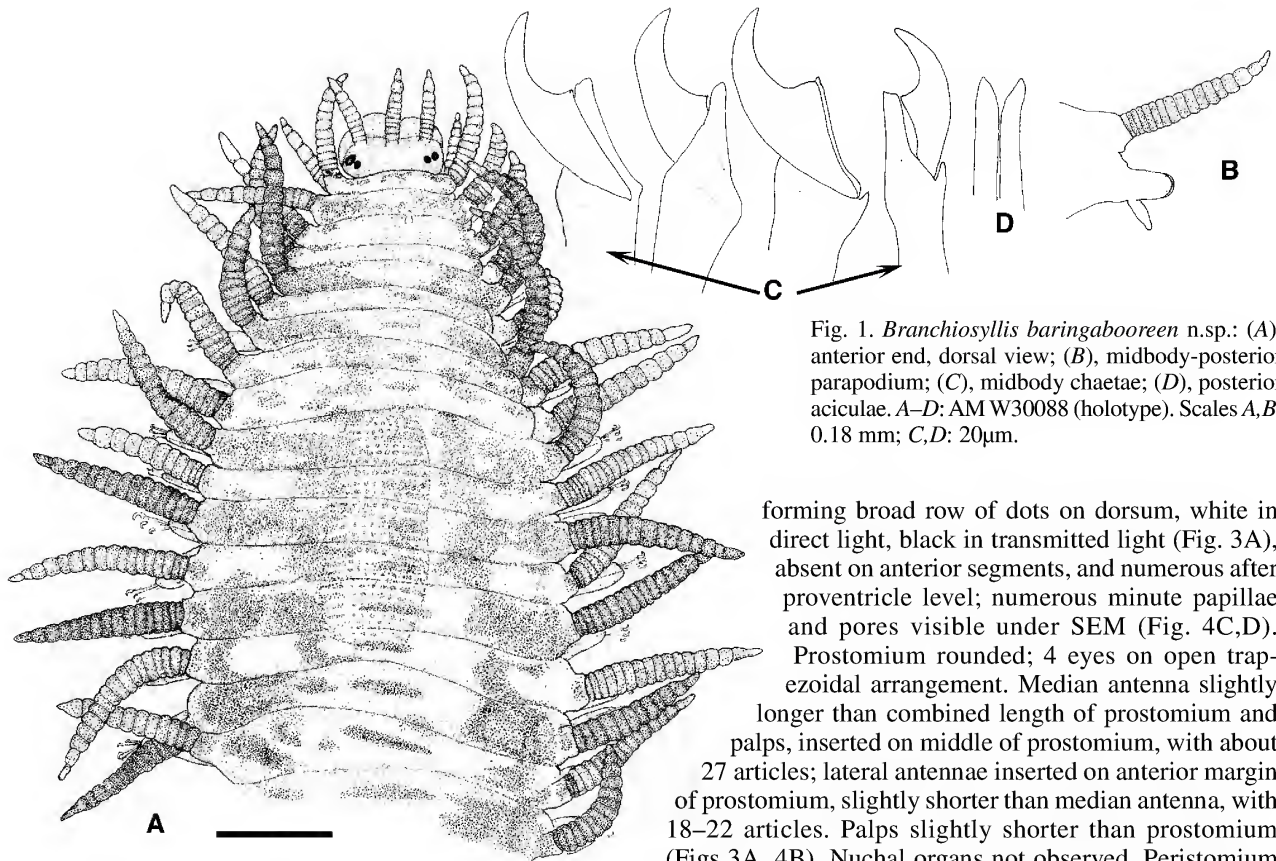


Fig. 1. *Branchiosyllis baringabooreen* n.sp.: (A), anterior end, dorsal view; (B), midbody-posterior parapodium; (C), midbody chaetae; (D), posterior aciculae. A–D: AM W30088 (holotype). Scales A,B: 0.18 mm; C,D: 20µm.

Remarks. *Branchiosyllis baringabooreen* n.sp., is characterized by having the combination of a flattened body, with a distinctive black and white colour pattern, lacking branchiae on the parapodial lobes, and in the distribution of falcigers, three of them claw-like with blades rotated 180° and one unmodified. On some parapodia, all falcigers are claw-shaped. This colour pattern is not found in any other species of *Branchiosyllis*.

Etymology. The specific name is derived from two aboriginal words; *Baringa*, meaning light, and *Booreen*, meaning dark, in reference to the distinctive colour pattern of this species.

Habitat. Intertidal to shallow subtidal in sand and in amongst coral rubble.

Distribution. Australia (North Western Australia).

Branchiosyllis carmenroldanae n.sp.

Figs 3A–D, 4A–F

Material examined. HOLOTYPE (AM W30118) PARATYPES, 4 (1 on SEM stub), (AM W30119) **Western Australia:** Goss Passage, Beacon Is., 28°25'30"S 113°47'E, dead plates of *Acropora* sp., covered in coralline algae, 8 m, coll. P.A. Hutchings, 19 May 1994.

Description. Holotype 30 mm long, 0.4 mm wide, with 106 chaetigers, plus an attached acephalous stolon, 1.3 mm long, with 15 chaetigers. Body cylindrical dorsally (Figs 3A, 4A), long and slender, white in alcohol; dermal glands

forming broad row of dots on dorsum, white in direct light, black in transmitted light (Fig. 3A), absent on anterior segments, and numerous after proventricle level; numerous minute papillae and pores visible under SEM (Fig. 4C,D). Prostomium rounded; 4 eyes on open trapezoidal arrangement. Median antenna slightly longer than combined length of prostomium and palps, inserted on middle of prostomium, with about 27 articles; lateral antennae inserted on anterior margin of prostomium, slightly shorter than median antenna, with 18–22 articles. Palps slightly shorter than prostomium (Figs 3A, 4B). Nuchal organs not observed. Peristomium shorter than subsequent segments, with small anterior lobe (Figs 3A, 4B); dorsal tentacular cirri longer than median antenna, with about 15 articles, ventral ones shorter than dorsal tentacular cirri, with 9–10 articles. Dorsal cirri spindle-shaped, provided with distinct cirrophores, and short, indistinct articles (Figs 3A, 4A,B,E). Dorsal cirri of chaetiger 1 long, with 50–55 articles (Fig. 3A); subsequent dorsal cirri alternating long and short, long with up to 47, and short, with 35 articles in midbody segments. Parapodial lobes distally bilobed, prechaetal and postchaetal lobes rounded (Fig. 3B), postchaetal lobes larger than anterior ones (Fig. 4E). Ventral cirri digitiform, similar in length to parapodial lobes. Parapodia usually without obvious chaetae (Fig. 4E), with 1–2 short chaetae in few parapodia of some specimens; in some cases minute, difficult to see chaetae embedded in parapodial lobes (Fig. 3B). Blades of chaetae when present falcigerous, unidentate (Figs 3C, 4F); in some anterior segments, one falciger has a normal blade and another has a curved, claw-shaped blade; on midbody and posterior segments, two claw-shaped falcigers, may be present. Anterior parapodia each with 2–3 unequal, relatively thick aciculae, slightly oblique at tip (Fig. 4E); from midbody onwards, solitary acicula, thick, and distally oblique (Fig. 3D). Pharynx through about 6 segments; pharyngeal tooth anteriorly located (Fig. 3A), surrounded by crown of 10 soft papillae. Proventricle similar in length to pharynx, present through 6 segments, with about 50 muscle cell rows. Pygidium small, with 2 anal cirri similar to dorsal cirri.

Remarks. *Branchiosyllis carmenroldanae* n.sp., is characterized by having a thin, slender body, with a broad band of dots on each segment, spindle-shaped cirri, with indistinct

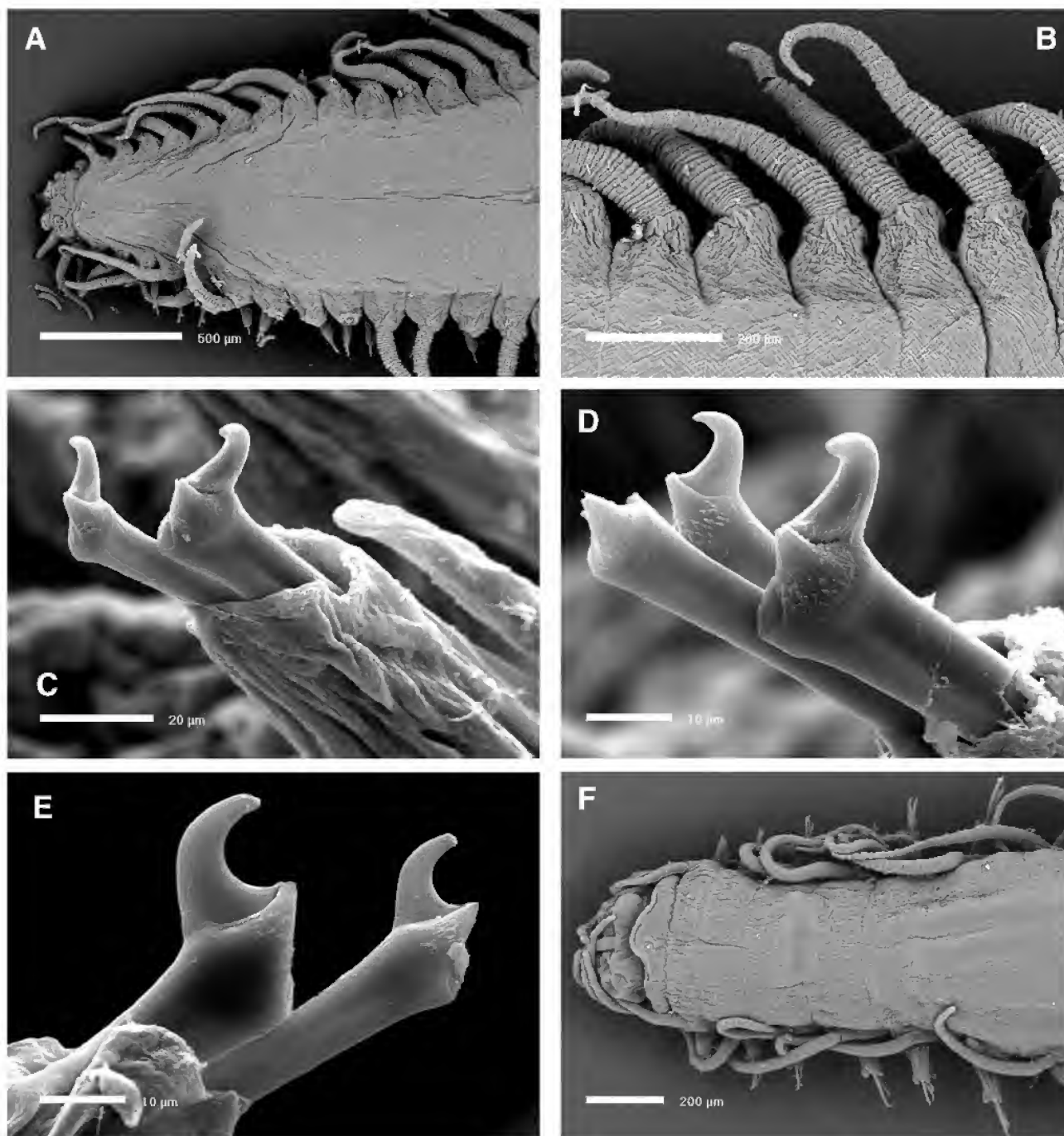


Fig. 2. SEM of *Branchiosyllis baringabooreen* n.sp.: (A), anterior end, dorsal view; (B), midbody dorsal cirri; (C–E), midbody and posterior chaetae. SEM of *Branchiosyllis cirropunctata* (Michel, 1909): (F), anterior end, dorsal view. A–E: AM W29247, F: AM W30093.

articles, thick aciculae, bilobed parapodial lobes, and especially by the lack of chaetae. All material examined is in good condition. Most parapodia lack chaetae or if they are present, they are minute, embedded in the parapodial lobe. Smaller specimens have some parapodia with chaetae or only shafts. Specimens of other species of Syllidae found in the same sample have numerous chaetae, so we consider that the near complete absence of chaetae is a valid character for this species and not the result of damage during collection. We believe that the chaetae are lost as the individual grows.

Habitat. Found on dead plates of *Acropora* sp., covered in coralline algae, 8 m.

Distribution. Australia (Central Western Australia).

Etymology. The species is named after Dr Carmen Roldán, friend and colleague, and who was the professor of the first author (GSM) in the University Complutense of Madrid.

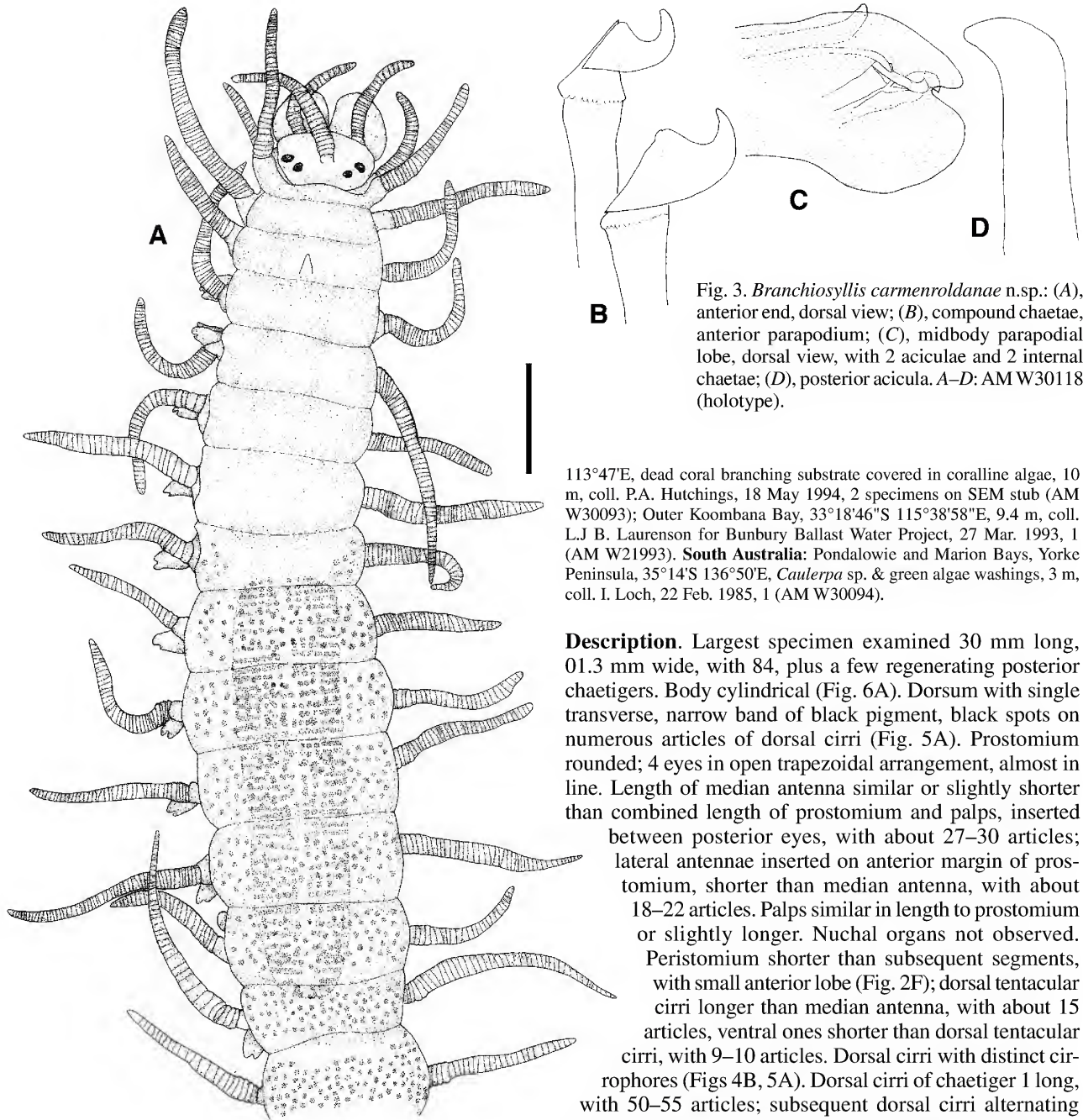


Fig. 3. *Branchiosyllis carmenroldanae* n.sp.: (A), anterior end, dorsal view; (B), compound chaetae, anterior parapodium; (C), midbody parapodial lobe, dorsal view, with 2 aciculae and 2 internal chaetae; (D), posterior acicula. A–D: AM W30118 (holotype).

113°47'E, dead coral branching substrate covered in coralline algae, 10 m, coll. P.A. Hutchings, 18 May 1994, 2 specimens on SEM stub (AM W30093); Outer Koombana Bay, 33°18'46"S 115°38'58"E, 9.4 m, coll. L.J. B. Laurenson for Bunbury Ballast Water Project, 27 Mar. 1993, 1 (AM W21993). **South Australia:** Pondalowie and Marion Bays, Yorke Peninsula, 35°14'S 136°50'E, *Caulerpa* sp. & green algae washings, 3 m, coll. I. Loch, 22 Feb. 1985, 1 (AM W30094).

Description. Largest specimen examined 30 mm long, 01.3 mm wide, with 84, plus a few regenerating posterior chaetigers. Body cylindrical (Fig. 6A). Dorsum with single transverse, narrow band of black pigment, black spots on numerous articles of dorsal cirri (Fig. 5A). Prostomium rounded; 4 eyes in open trapezoidal arrangement, almost in line. Length of median antenna similar or slightly shorter than combined length of prostomium and palps, inserted between posterior eyes, with about 27–30 articles; lateral antennae inserted on anterior margin of prostomium, shorter than median antenna, with about 18–22 articles. Palps similar in length to prostomium or slightly longer. Nuchal organs not observed. Peristomium shorter than subsequent segments, with small anterior lobe (Fig. 2F); dorsal tentacular cirri longer than median antenna, with about 15 articles, ventral ones shorter than dorsal tentacular cirri, with 9–10 articles. Dorsal cirri with distinct cirrophores (Figs 4B, 5A). Dorsal cirri of chaetiger 1 long, with 50–55 articles; subsequent dorsal cirri alternating long and short, with up to 47 and 35 articles respectively on midbody. Parapodial lobes distally bilobed, prechaetal and postchaetal lobes digitiform, similar in length and shape, posterior one slightly wider (Figs 5A, 6B). Ventral cirri digitiform, similar in length to parapodial lobes. Typically 9–10 compound heterogomph chaetae on anterior parapodia, blades falcigerous, slightly bidentate, smooth on margin (Fig. 5B), all similar, with slender shafts, blades 20 µm; on posterior parapodia, shafts becoming larger, with more marked angular shafts on ventral chaetae, marginally smooth, unidentate (Figs 5D, 6C, 8A). Posterior parapodia with blades of some (1–2) ventral falcigers rotated 180°, becoming claw-shaped, with short shafts; remaining 5–6 falcigers with thick shafts and pronounced subdistal spur (below point of articulation) with blade and hooked blades, unidentate or slightly bidentate (Fig. 6D,E), 37–33 µm long. Most posterior parapodia with only claw-shaped falcigers, shafts enlarged,

Branchiosyllis cirropunctata
(Michel, 1909), n.comb.

Figs 2F, 5A–F, 6A–F, 8A

Syllis (*Typosyllis*) *cirropunctata* Michel, 1909: 318.–Fauvel, 1923: 266, figs 99n–p.–Day, 1967: 250, fig. 12.4k–l; 1975: 190.

Typosyllis (*Typosyllis*) *cirropunctata*.–Hartmann-Schröder, 1984: 14, figs 13–15; 1985: 65; 1986: 38.

Material examined. **Western Australia:** Goss Passage, Beacon Island, 28°25'30"S 113°47'E, dead plates of *Acropora* sp. covered in coralline algae, 8 m, coll. P.A. Hutchings, 19 May 1994, 2 (AM W30091); NE entrance to Goss Passage, Beacon Island, 28°27'54"S 113°46'42"E, dead plate-like *Acropora* sp. covered in coralline algae, 8 m, coll. P.A. Hutchings, 25 May 1994, 1 (AM W30092); Goss Passage, Beacon Island, 28°25'30"S

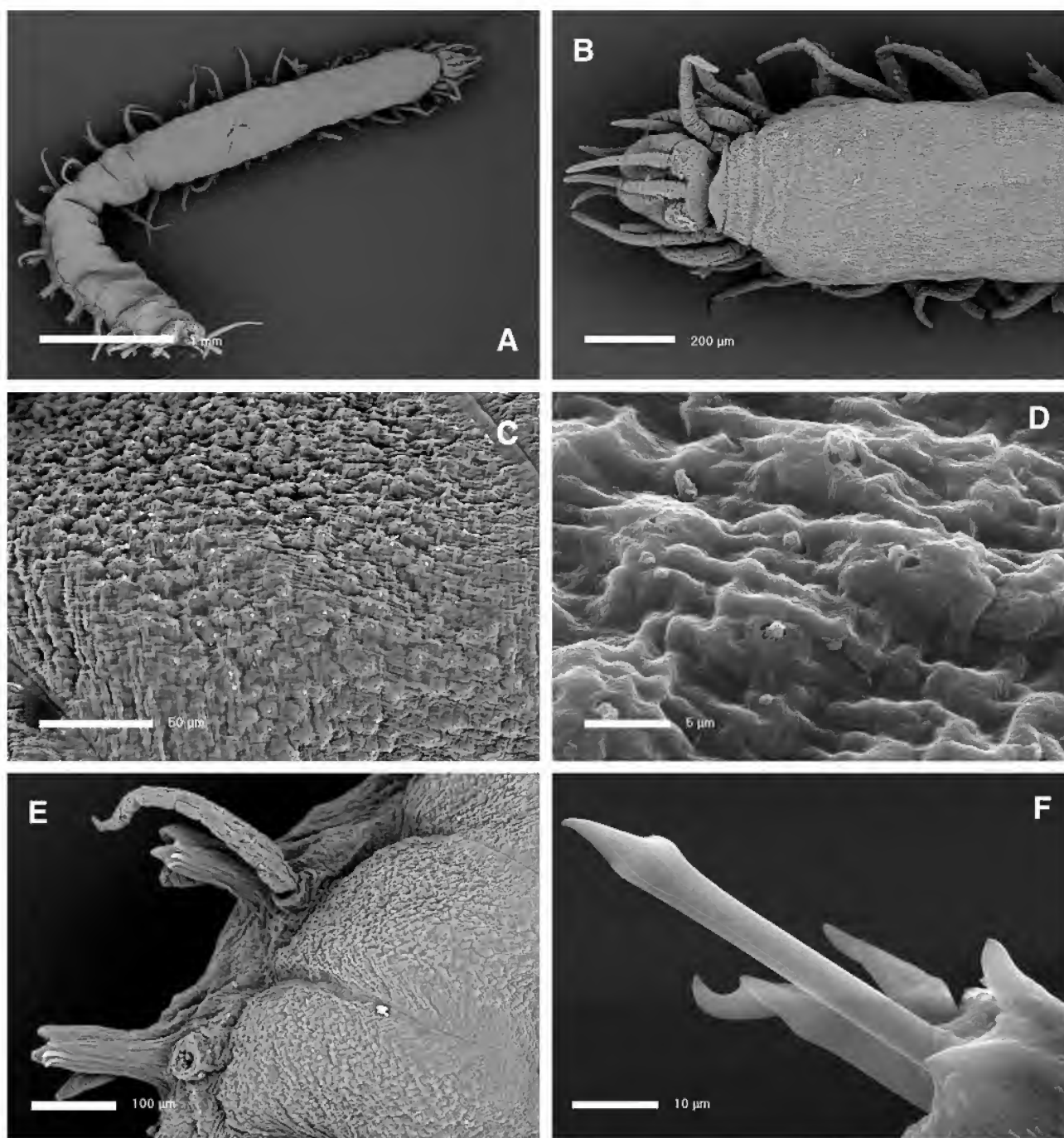


Fig. 4. SEM of *Branchiosyllis carmenroldanae* n.sp.: (A), dorsal view of an incomplete specimen; (B), anterior end, dorsal view; (C), dorsum; (D), detail of dorsal pores; (E), mid-posterior parapodia, dorsal view, showing the emergent aciculae; (F), chaetae. A–F: AM W30119.

with pronounced protruberances below point of articulation with blade (Figs 4F, 5F). Anterior parapodia each with 3–4 slender aciculae, all straight, pointed (Fig. 5C); from midbody onwards, number of aciculae per parapodium decreasing to 2 in each posterior parapodium, of different sizes, slightly obliquely expanded at tips (Fig. 5E). Pharynx through 6–7 segments; pharyngeal tooth located anteriorly, surrounded by crown of 10 soft papillae. Proventricle similar in length to pharynx, through 6 segments, with 40–42 muscle cell rows, and distinct mid-dorsal line. Pygidium small, with 2 anal cirri similar to dorsal cirri. Some specimens with attached acephalous stolon, small, short, only 8–10 chaetigers.

Remarks. *Branchiosyllis maculata* (Imajima, 1966) and *B. cirropunctata*, are similar in body size, shape and colour pattern. However, the former has posterior parapodia with claw-shaped falcigers and unmodified, normal, unidentate falcigers, and shafts with small subdistal spurs below the point of articulation (Fig. 13A,B). *Branchiosyllis cirropunctata*, has claw-shaped falcigers only on far posterior segments, and they have large subdistal spurs on the head of the shaft (Fig. 6F).

San Martín (2003) and Licher (1999) erroneously considered *Syllis cirropunctata* as a synonym of *Branchiosyllis exilis* (Gravier, 1900), based on specimens from the Spanish Mediterranean, as they share a similar colour pattern; but

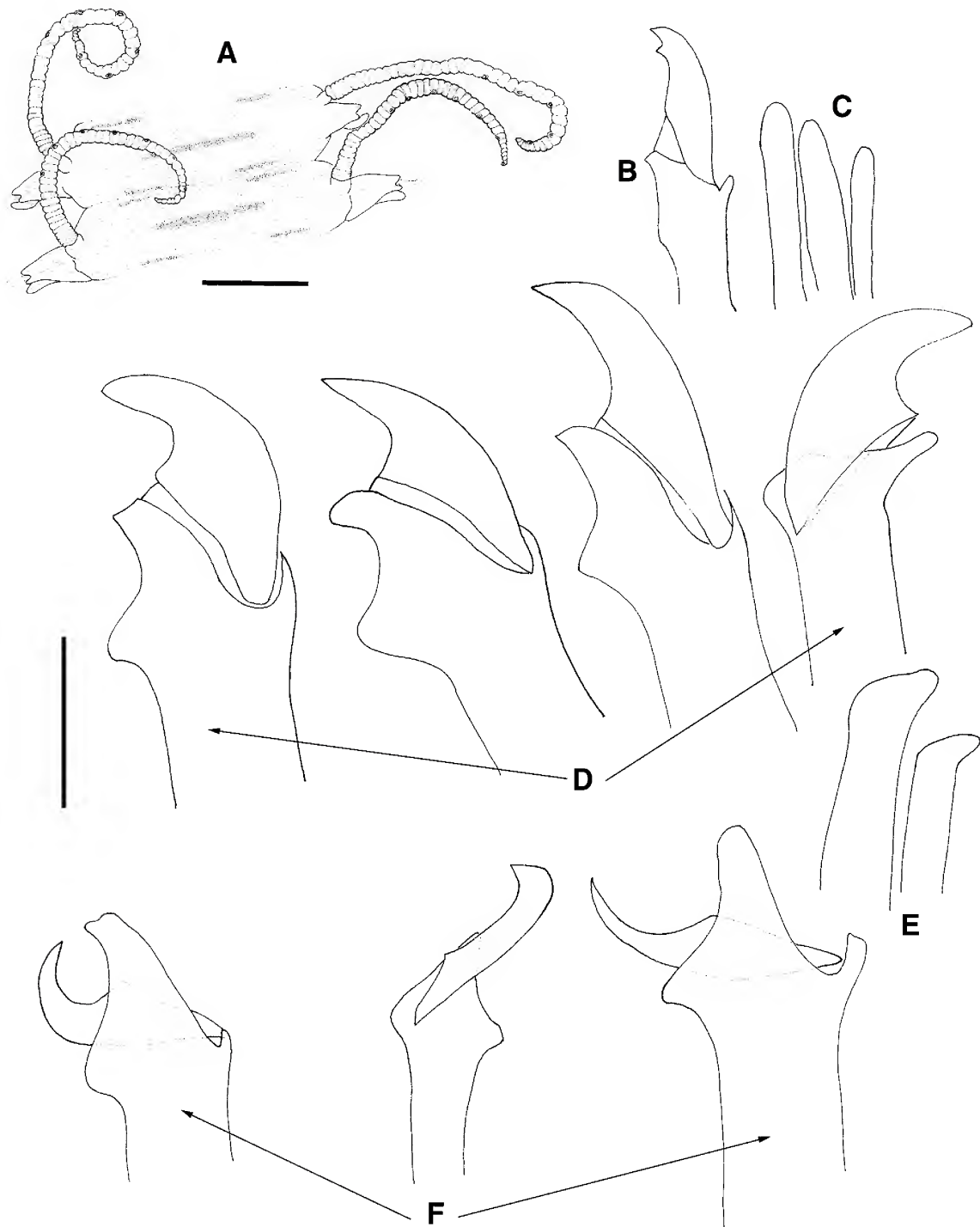


Fig. 5. *Branchiosyllis cirropunctata* (Michel, 1909): (A), midbody segments, dorsal view; (B), compound chaeta, from 1st parapodium; (C), aciculae, anterior parapodium; (D), midbody chaetae; (E), posterior aciculae; (F), posterior chaetae. A: AM W21993. B–F: AM W30097. Scales A, 0.37 mm, B–F 20 μ m.

these specimens lack falcigers with the head of the shaft with protruberances; we now consider them as distinct species.

Habitat. Shallow water associated with algae.

Distribution. Mediterranean, Central Pacific, Indian Ocean, Australia (Central and South Western Australia and South Australia).

Branchiosyllis exilis (Gravier, 1900)

Figs 7A–F, 8B–F, 10A–B

Syllis (*Typosyllis*) *exilis* Gravier, 1900: 160, figs 28–30.–Augener, 1913: 192.

Trypanosyllis uncinigera Hartmann-Schröder, 1960: 86, figs 54–58.

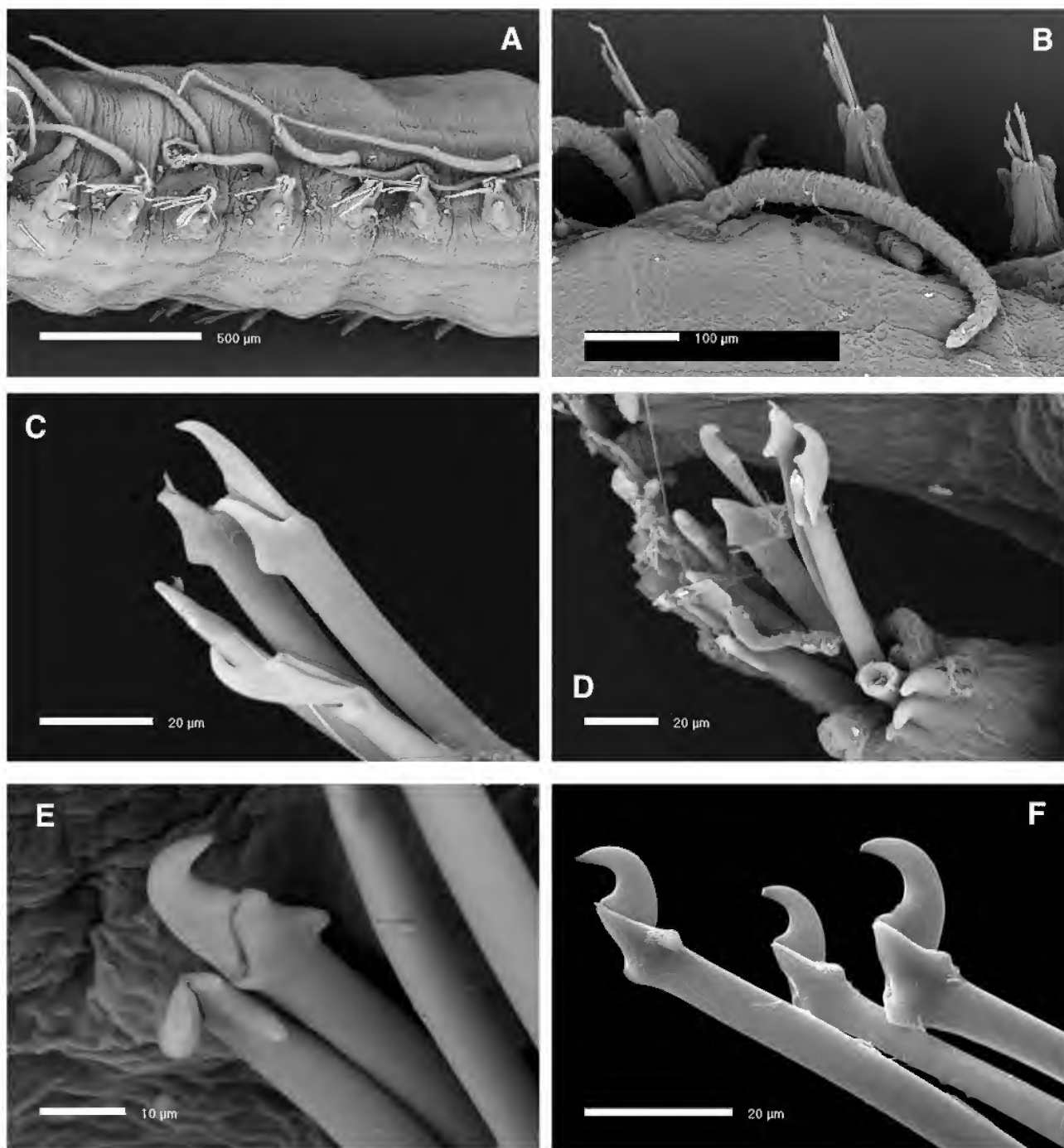


Fig. 6. SEM of *Branchiosyllis cirropunctata* (Michel, 1909): (A), midbody segments, lateroventral view; (B), midbody parapodia, dorsal view; (C), anterior-medium chaetae; (D), mid-posterior chaetae; (E), mid-posterior chaeta; (F), posterior chaetae. A–F: AM W30093.

Branchiosyllis uncinigera Harlock & Laubier, 1966: 18, figs 1–3.

?*Branchiosyllis exilis* Westheide, 1974: 60, fig. 26.—Uebelacker, 1984: 30–105, fig. 30–100.—San Martín, 1984: 294, figs 69–72; 1991: 233; 2003: 332, figs 184, 185.—Hartmann-Schröder, 1986: 37; 1991: 24, figs 14–18.—Capa *et al.*, 2001 a: 105.—Aguado *et al.*, 2008: 6–7, figs 1, 2.

?*Syllis* (*Typosyllis*) *fuscusuturata* Augener, 1922: 43.

?*Syllis fuscusuturata* Monro, 1933: 32, text-fig. 14.

Material examined. **Western Australia:** Kimberley region Bernouli Is. 15°S 124°47'E, sandy substrate with coral rubble, intertidal, coll. P.A. Hutchings, 12 July 1988, 4 (AM W30095); Reef S of Lucas Is., Brunswick Bay, 15°16'S 124°29'E, dead coral and *Sargassum* with heavy silt loading, 2

m, coll. P.A. Hutchings, 24 July 1988, 8 (AM W30096); SW corner of Lucas Is., 15°13'S 124°31'E, dead coral substrate, 2–30 m, coll. P.A. Hutchings, 24 July 1988, 1 (AM W30099); Inshore reef off Neds Camp, Cape Range National Park, 21°59'S 113°59'E, *Caulerpa* sp., 1 m, coll. J.K. Lowry, 2 Jan. 1984, 10 (AM W30101); Bush Bay, 30 km S of Carnarvon, 25°10'S 113°39'E, extensive shallow sand flats, brown algal covered cockle shells, 0.5 m, coll. H.E. Stoddart, 6 Jan. 1984, 1 (AM W30102); Houtman Abrohlos, Goss Passage, Beacon Is., 28°25'30"S 113°47'E, dead coral substrate in fine sediment at foot of reef slope, 33 m, coll. P.A. Hutchings, 23 May 1994, 1 (AM W30097); off S end of Long Is., 28°28'48"S 113°46'18"E, dead coral substrate covered in coralline algae, 5 m, coll. P.A. Hutchings, 25 May 1994, 5 (AM W30098); E side of West Wallabi Is., 28°27'54"S 113°40'54"E, *Posidonia australis* root mat with epifauna, 2 m, coll. P.A. Hutchings, 26 May 1994, 4 (AM W30100). **Tasman Sea,** reef flat near wreck "Yoshin Maru Iwaki", Elizabeth Reef, 29°55'48"S 159°01'18"E, small heads of

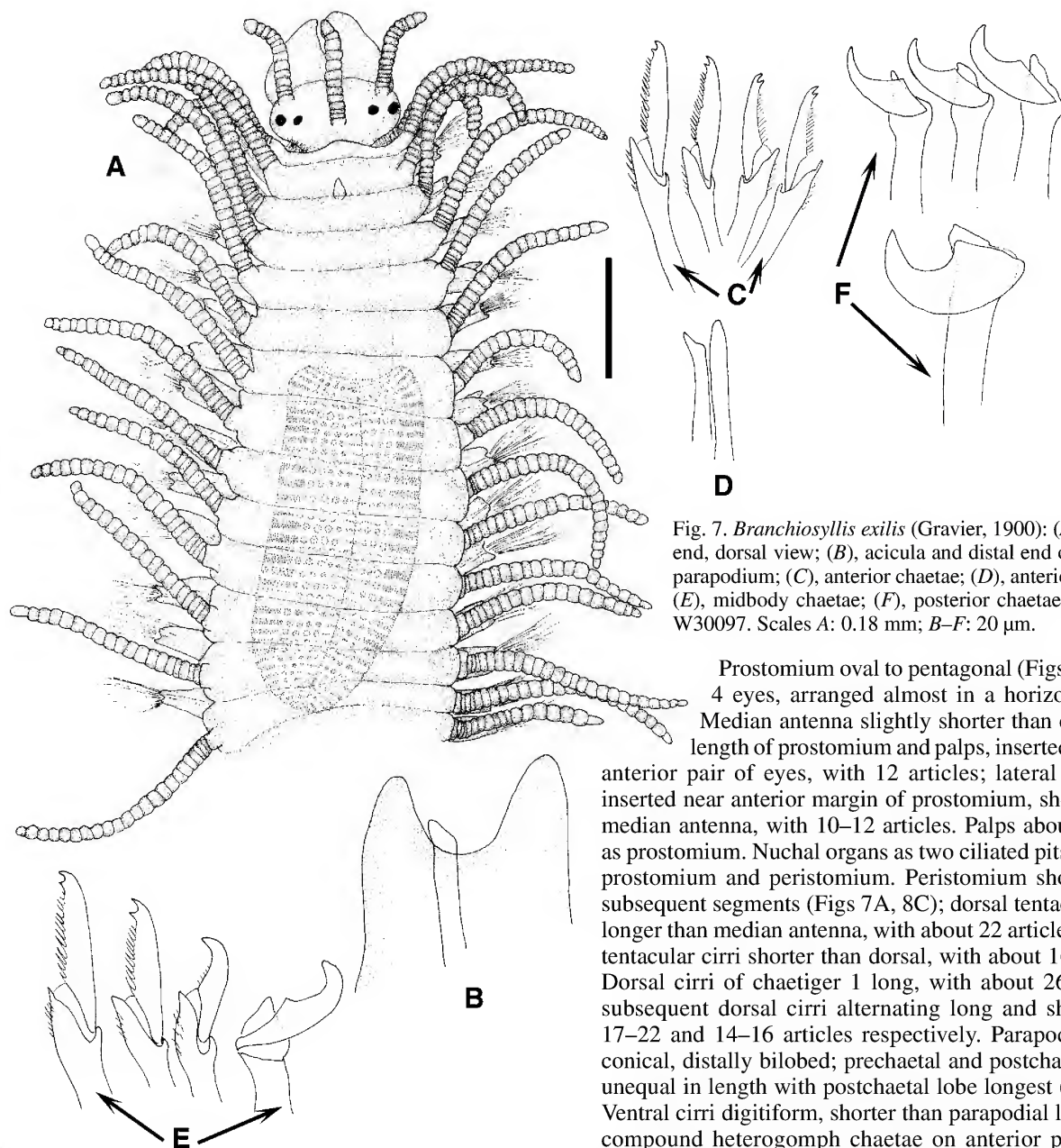


Fig. 7. *Branchiosyllis exilis* (Gravier, 1900): (A), anterior end, dorsal view; (B), acicula and distal end of posterior parapodium; (C), anterior chaetae; (D), anterior aciculae; (E), midbody chaetae; (F), posterior chaetae. A–F: AM W30097. Scales A: 0.18 mm; B–F: 20 μ m.

Prostomium oval to pentagonal (Figs 7A, 8C); 4 eyes, arranged almost in a horizontal line.

Median antenna slightly shorter than combined length of prostomium and palps, inserted between anterior pair of eyes, with 12 articles; lateral antennae inserted near anterior margin of prostomium, shorter than median antenna, with 10–12 articles. Palps about as long as prostomium. Nuchal organs as two ciliated pits between prostomium and peristomium. Peristomium shorter than subsequent segments (Figs 7A, 8C); dorsal tentacular cirri longer than median antenna, with about 22 articles, ventral tentacular cirri shorter than dorsal, with about 16 articles. Dorsal cirri of chaetiger 1 long, with about 26 articles; subsequent dorsal cirri alternating long and short, with 17–22 and 14–16 articles respectively. Parapodial lobes conical, distally bilobed; prechaetal and postchaetal lobes unequal in length with postchaetal lobe longest (Fig. 7B). Ventral cirri digitiform, shorter than parapodial lobes. 6–8 compound heterogomph chaetae on anterior parapodia, blades falcigerous, bidentate (Figs 7C, 8D), with marginal short spines, upper blades 22–23 μ m, lower ones 15 μ m, changing progressively along body, with some blades becoming unidentate and marginally smooth; from midbody onwards some chaetal blades rotated 180°, becoming claw-shaped; number of claw-shaped falcigers increasing and unmodified falcigers decreasing posteriorly (Figs 7E, 8E, F, 10A); posterior parapodia with 4–5 claw-shaped falcigers, differing in size, with larger ones ventrally (Figs 7F, 10B). Anterior parapodia with 2 slender aciculae, 1 straight and 1 with tip slightly oblique (Figs 7D, 8D); from midbody posteriorly, single acicula in each parapodium, thicker than anterior ones, with tip slightly deflected (Fig. 7B). Pharynx through 5–6 segments; pharyngeal tooth located anteriorly (Fig. 7A). Proventricle longer than pharynx, through 7–8 segments, with 27–30 muscle cell rows. Pygidium small, with 2 anal cirri similar in shape and length to dorsal cirri.

Acropora valida, *Pocillopora damicornis*, intertidal, coll. J.K. Lowry & R.T. Springthorpe, 14 Dec. 1987, 26 (4 on SEM stub), (AM W30103); Taupo Seamount, 33°16'51"S 156°09'09"E, benthic sled, 244 m, coll. J.K. Lowry on RV "Franklin", 2 May 1989, few (AM W30106). **New South Wales:** SW side of South Solitary Is., 30°12'S 153°16'E, coral rubble, 18 m, coll. R.T. Springthorpe, 24 June 1992, 1 (AM W30104); Manta Reef, North West Solitary Is., 30°01'30"S 153°16'30"E, lace bryozoan, 19 m, coll. R.T. Springthorpe, 25 June 1992, 1 (AM W30105). **Northern Territory:** Lee Point, Darwin Harbour, 12°20'S 130°53'48"E, dead coral rubble washings, 3 m, coll. P.A. Hutchings, 11 July 1993, 1 (AM W30107).

Additional material examined. 2 syntypes of *Syllis* (*Typosyllis*) *fuscosuturata*, Tortugas Is. (Florida, USA), SW Channel & third Key Rift, ZMB 6598. *Syllis exilis* Gravier, 1900, Djibouti, Gulf of Aden, holotype, MNHN polytype 143.

Description. Largest specimen examined 6 mm long, 0.45 mm wide, with 50 segments, but some specimens reported from other areas of greater length and with more segments. Body cylindrical in dorsal view (Fig. 8B). Dorsum of some specimens with transverse bands on some anterior segments and black spots on some articles of dorsal cirri.

Remarks. *Branchiosyllis exilis* belongs to the group of species having a cylindrical body, lacking branchiae,

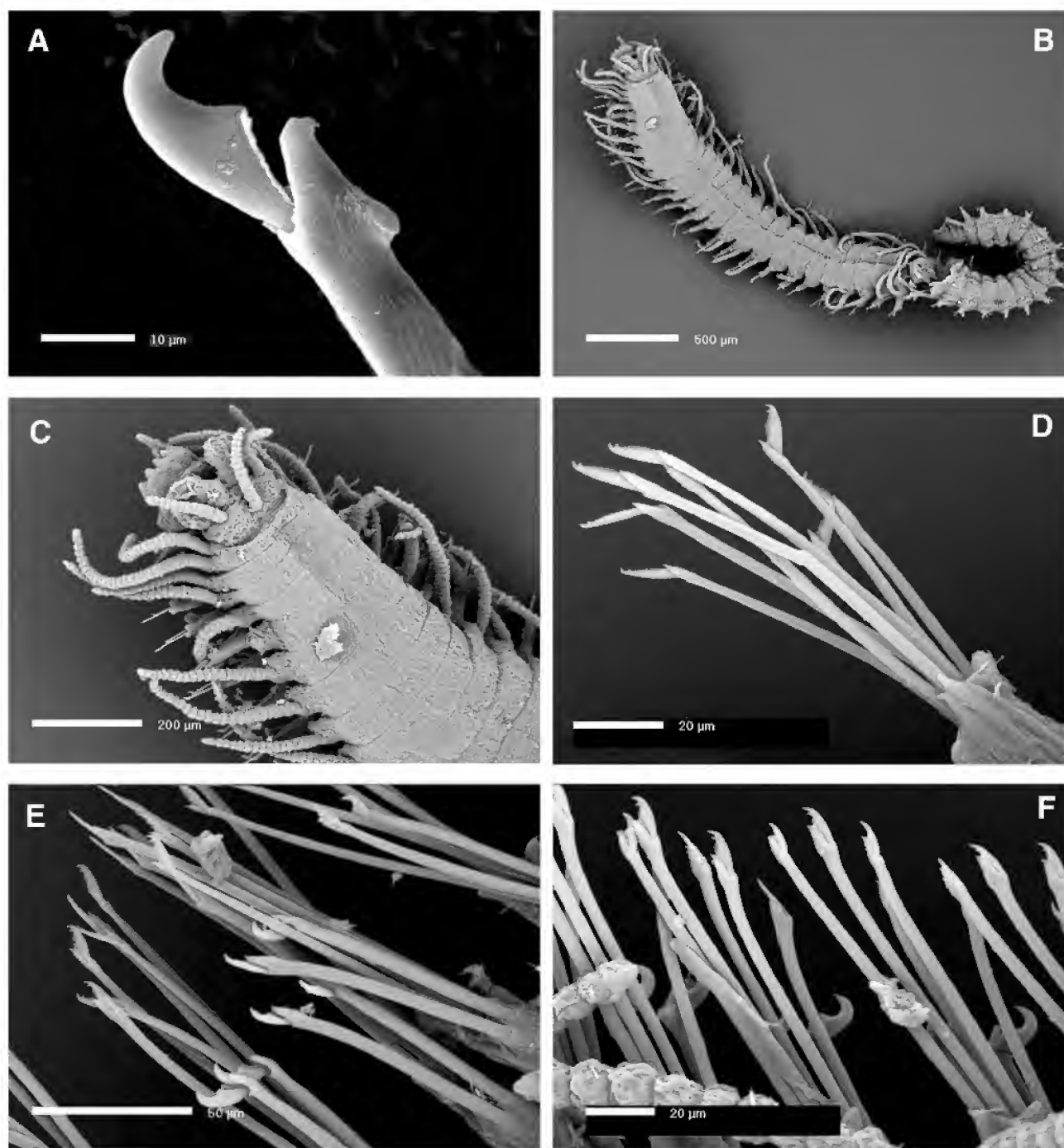


Fig. 8. SEM of *Branchiosyllis cirropunctata* (Michel, 1909): (A), posterior chaeta. SEM of *Branchiosyllis exilis* (Gravier, 1900): (B), complete specimen, dorsal view; (C), anterior end, dorsal view; (D), chaetae, anterior parapodium; (E), anterior-midbody chaetae; (F), posterior-midbody chaetae. A: AM W30093; B–F: AM W30103.

and having both normal (unmodified) and claw-shaped falcigers. This group consists of *Branchiosyllis verruculosa*, described below, *Branchiosyllis lorenae* San Martín & Bone, 1999, from the Caribbean Sea (San Martín & Bone, 1999), *Branchiosyllis salina* (Hartmann-Schröder, 1959) (questionable), *B. maculata* (Imajima, 1966), and *B. bathyalis* (Kirkegaard, 1995) (see Licher, 1999). *Branchiosyllis exilis* can be distinguished from these species by the structure of the falcigers. Some of these species have only one claw-shaped falciger in posterior parapodia, and others have both normal falcigers and claw-shaped falcigers in posterior parapodia. Syntypes of *Syllis fuscotuturata* Augener, 1922, differ from

Australian specimens of *B. exilis* in having longer dorsal cirri, and distally hooked shafts, but it is certainly a member of *Branchiosyllis*. A detailed revision of the entire *B. exilis* complex is needed.

Habitat. Found in shallow depths to 244 m in amongst coral rubble and algae.

Distribution. Circumtropical, warmer areas of the Mediterranean Sea, Australia (North and central Western Australia, South Australia, New South Wales, Northern Territory).

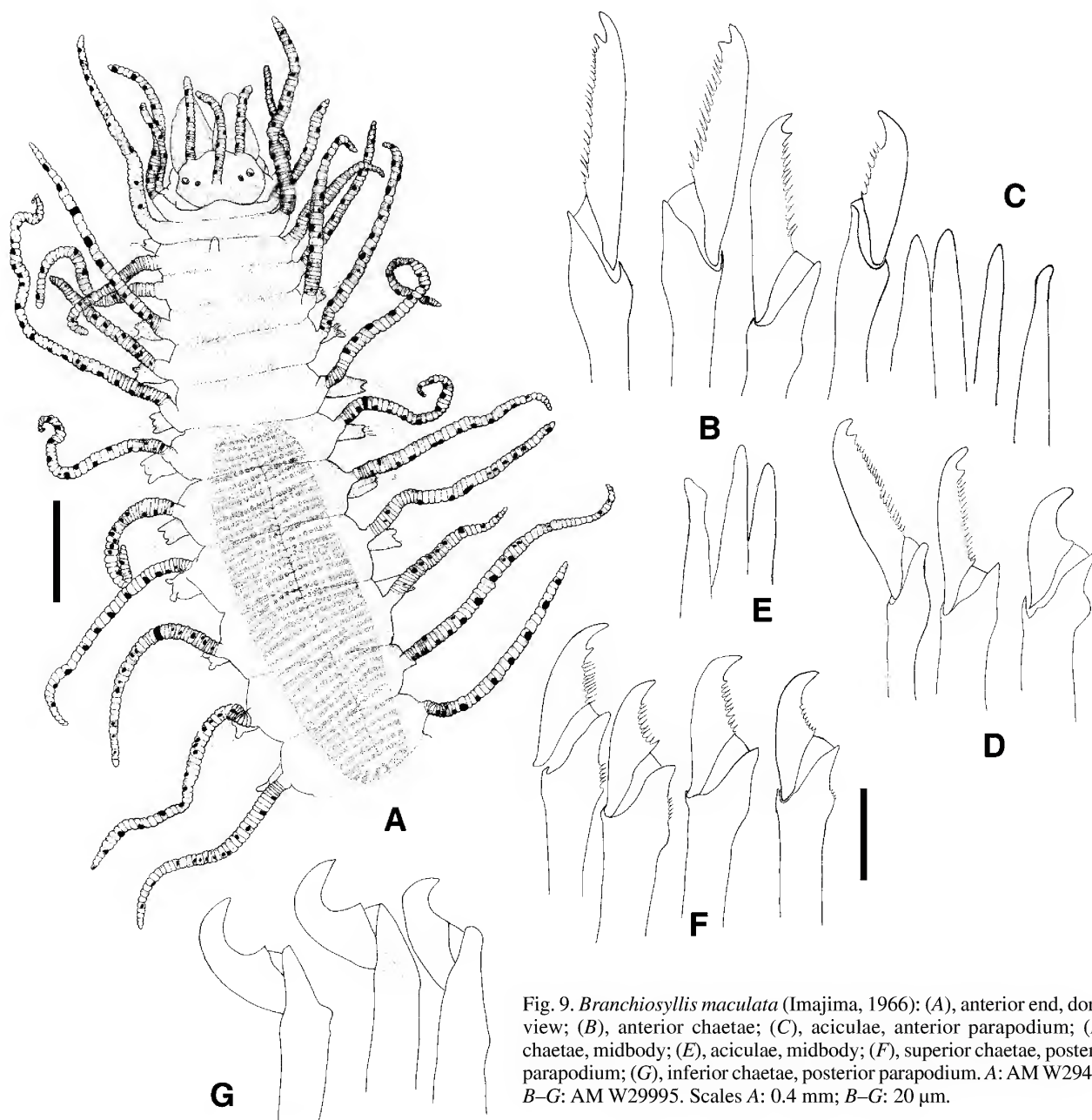


Fig. 9. *Branchiosyllis maculata* (Imajima, 1966): (A), anterior end, dorsal view; (B), anterior chaetae; (C), aciculae, anterior parapodium; (D), chaetae, midbody; (E), aciculae, midbody; (F), superior chaetae, posterior parapodium; (G), inferior chaetae, posterior parapodium. A: AM W29495. B–G: AM W29995. Scales A: 0.4 mm; B–G: 20 μ m.

***Branchiosyllis maculata* (Imajima, 1966)**

Figs 9A–G, 10C–F, 11A–F, 13A,B

Typosyllis maculata Imajima, 1966: 277, text-fig. 59 a–m.
Branchiosyllis maculata Licher, 1999: 274.–Aguado *et al.*,
 2008; 10–13, figs 3–4

Material examined. **Western Australia:** inshore reef off Neds Camp, Cape Range National Park, 21°59'S 113°59'E, frilly *Caulerpa* sp., 1 m, coll. J.K. Lowry, 2 Jan. 1984, 4 (AM W30108); N end of beach, Bundegi Reef, Exmouth Gulf, 21°49'S 114°11'E, rocky rubble with sediment, brown alga with epiphytic growth, intertidal, coll. H.E. Stoddart, 4 Jan. 1984, 2 (AM W30109); N end of beach, Bundegi Reef, 21°49'S 114°11'E, rocky rubble & coralline algae with green epiphytes, 2 m, coll. H.E. Stoddart, 4 Jan. 1984, 4 (2 on SEM stub), (AM W30111); N end of beach, Bundegi Reef, 21°49'S 114°11'E, rocky rubble & brown alga with epiphytic growth, sticky sediment, 2 m, coll. H.E. Stoddart, 4 Jan. 1984, 3 (AM W29519); Goss Passage, Beacon Is., 28°25'30"S 113°47'E, dead plates of *Acropora* sp. covered in coralline algae, 8 m, coll. P.A. Hutchings, 19 May 1994, 3 (AM W30110).

Description. Largest specimen examined 11 mm long, 0.6 mm wide, with 62 chaetigers, plus an attached stolon, 0.7 mm long, with 10 chaetigers. Body cylindrical dorsally (Figs 9A, 10C). Dorsum of posterior segments with single transverse narrow band of black pigment, black spots on numerous articles of dorsal cirri; antennae, tentacular cirri and dorsal cirri of anterior segments typically without or with few spots (Fig. 9A); segments posterior to proventricular segments with some articles of dorsal cirri partially or totally black, usually 2–3 articles without pigment alternating with 1 pigmented; ventrum with scattered, black dots. Prostomium rounded; 4 eyes in open trapezoidal arrangement, almost in line (Fig. 9A). Median antenna similar in length or slightly shorter than combined length of prostomium and palps, inserted between posterior eyes, with about 27 articles. Lateral antennae inserted on anterior margin of prostomium, shorter than median antenna, with 18–22 articles. Palps similar in length to prostomium or slightly longer. Nuchal organs not

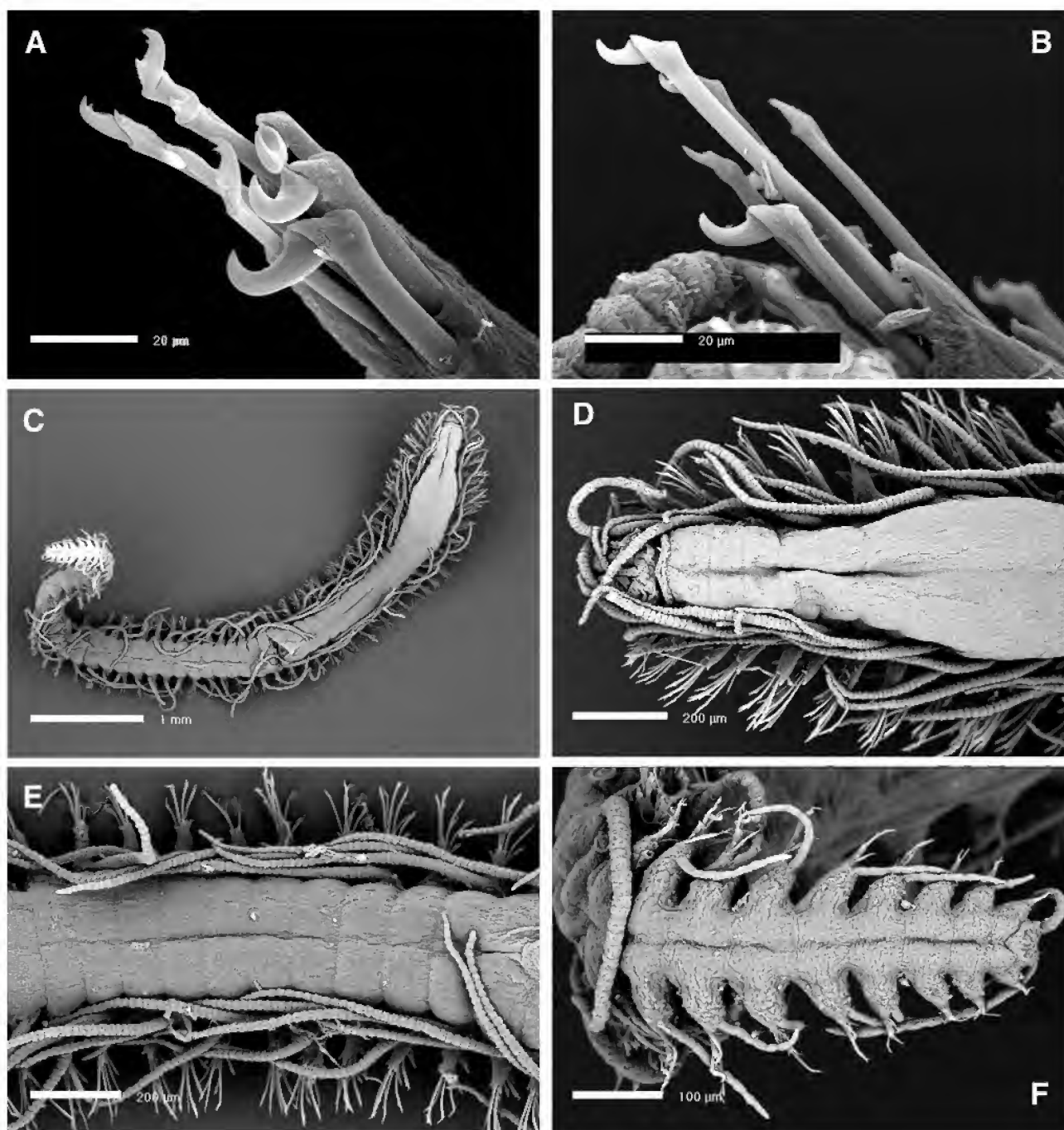


Fig. 10. SEM of *Branchiosyllis cirropunctata* (Michel, 1900): (A), midbody chaetal fascicle; (B), posterior chaetal fascicle. SEM of *Branchiosyllis maculata* (Imajima, 1966): (C), complete specimen, dorsal view, with stolon; (D), anterior end, dorsal view; (E), midbody, dorsal view; (F), stolon, dorsal view. A–B: AM W30093, C–F: AM W30111.

observed. Peristomium shorter than subsequent segments, with small anterior lobe (Figs 9A, 10D); dorsal tentacular cirri longer than median antenna, with about 15 articles, ventral ones shorter than dorsal tentacular cirri, with 9–10 articles. Dorsal cirri provided with distinct cirrophores. Dorsal cirri of chaetiger 1 long, with 50–55 articles; subsequent dorsal cirri alternating (Fig. 10D) long and short, with up to 47 and 35 articles respectively at midbody (Figs 9A, 10E). Parapodial lobes distally bilobed, prechaetal and postchaetal lobes digitiform (Figs 9A, 11D,E), unequal in length and shape. Ventral cirri digitiform, similar in length to parapodial lobes. Anterior parapodia with 9–10 compound

heterogomph falcigers, bidentate (Figs 9B, 11B,C), with short spines on margin, blades 41–42 µm above, 26 µm below. In more posterior parapodia, shafts developing larger protruberances (Figs 11E, 13A,B), more marked on ventral than dorsal chaetae, with short, smooth margin, unidentate. In posterior parapodia (Fig. 9F,G), blade of ventralmost 3–4 falcigers rotated 180°, becoming claw-shaped, with distinctly shorter shafts than those of normal straight falcigers; remaining 5–6 falcigers with shafts with short subdistal spurs and hooked blades, unidentate or slightly bidentate (Fig. 11F), about 30–35 µm long. Anterior parapodia each with 3–4 slender aciculae, all straight, pointed (Fig. 9C) except

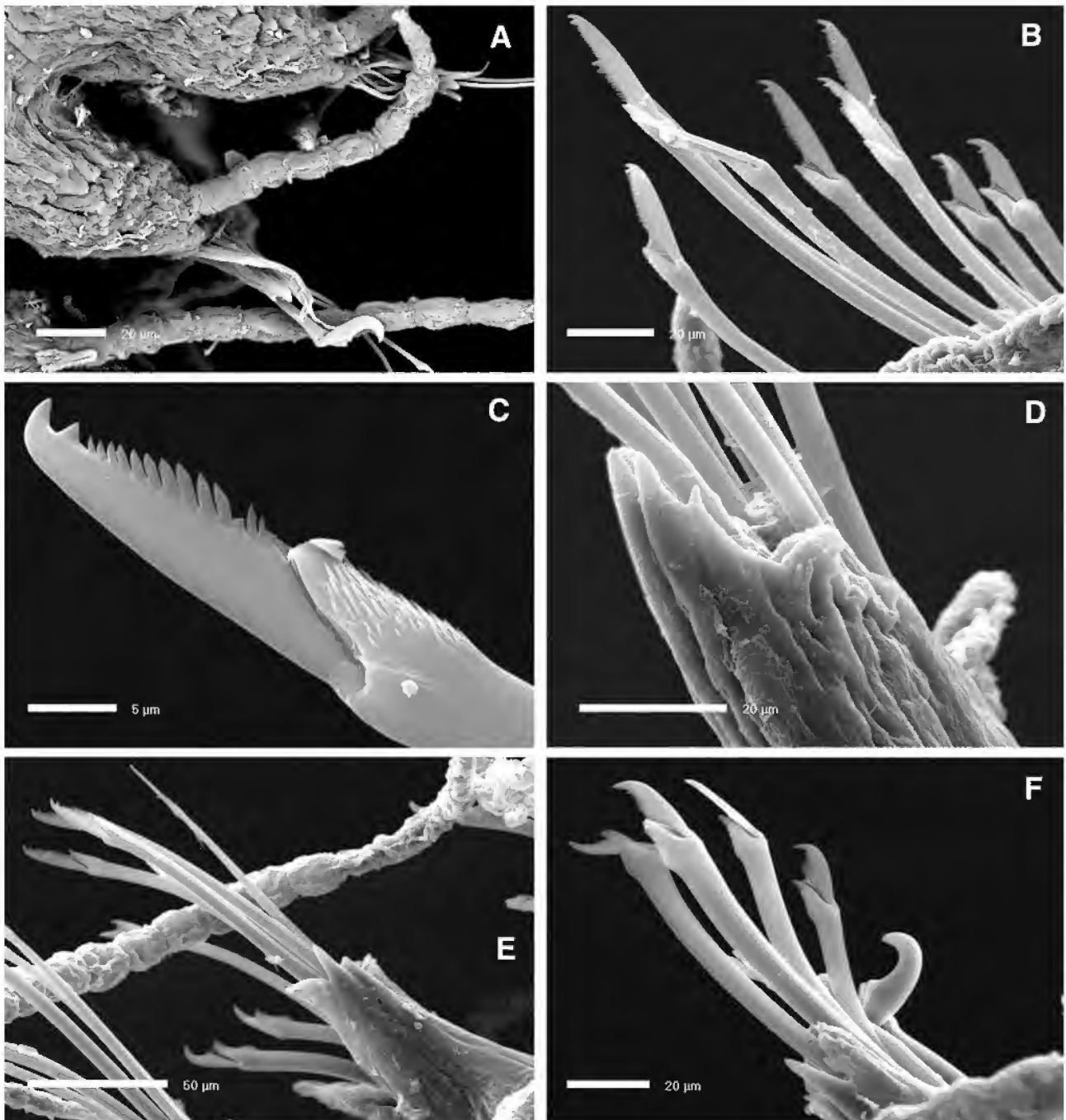


Fig. 11. SEM of *Branchiosyllis maculata* (Imajima, 1966): (A), detail of parapodium of stolon; (B), anterior chaetal fascicle; (C), anterior chaeta; (D), disal end of an anterior parapodial lobe, with emerging aciculae; (E), midbody chaetal fascicle; (F), anterior chaetal fascicle. A–F: AM W30111.

one slightly oblique at tip; from midbody posteriorly, number of aciculae per parapodium decreasing to 2 (Fig. 9E), one straight, pointed, slightly protruding from parapodial lobes, other slightly oblique at tip (Fig. 11E). Pharynx through 6–7 segments; pharyngeal tooth located anteriorly (Fig. 9A), surrounded by crown of 10 soft papillae. Proventricle similar in length to pharynx, present through 6 segments, with 40–42 muscle cell rows, and distinct mid-dorsal line. Pygidium small, with 2 anal cirri similar in length to dorsal cirri. Some specimens with attached acephalous stolon, small, short, with 8–10 chaetigers (Figs 10F, 11A).

Remarks. The claw-shaped falcigerous chaetae, typical of the genus *Branchiosyllis*, are difficult to observe in dorsal view, since they have short shafts, and in other views they may appear absent. This species is very similar to *B. cirropunctata* but the latter has all the posterior chaetae claw-shaped, with stouter subdistal spurs on shafts.

Habitat. Intertidal to shallow depths, in amongst coral rubble and algae.

Distribution. Japan (southern), Australia (Central Western Australia).

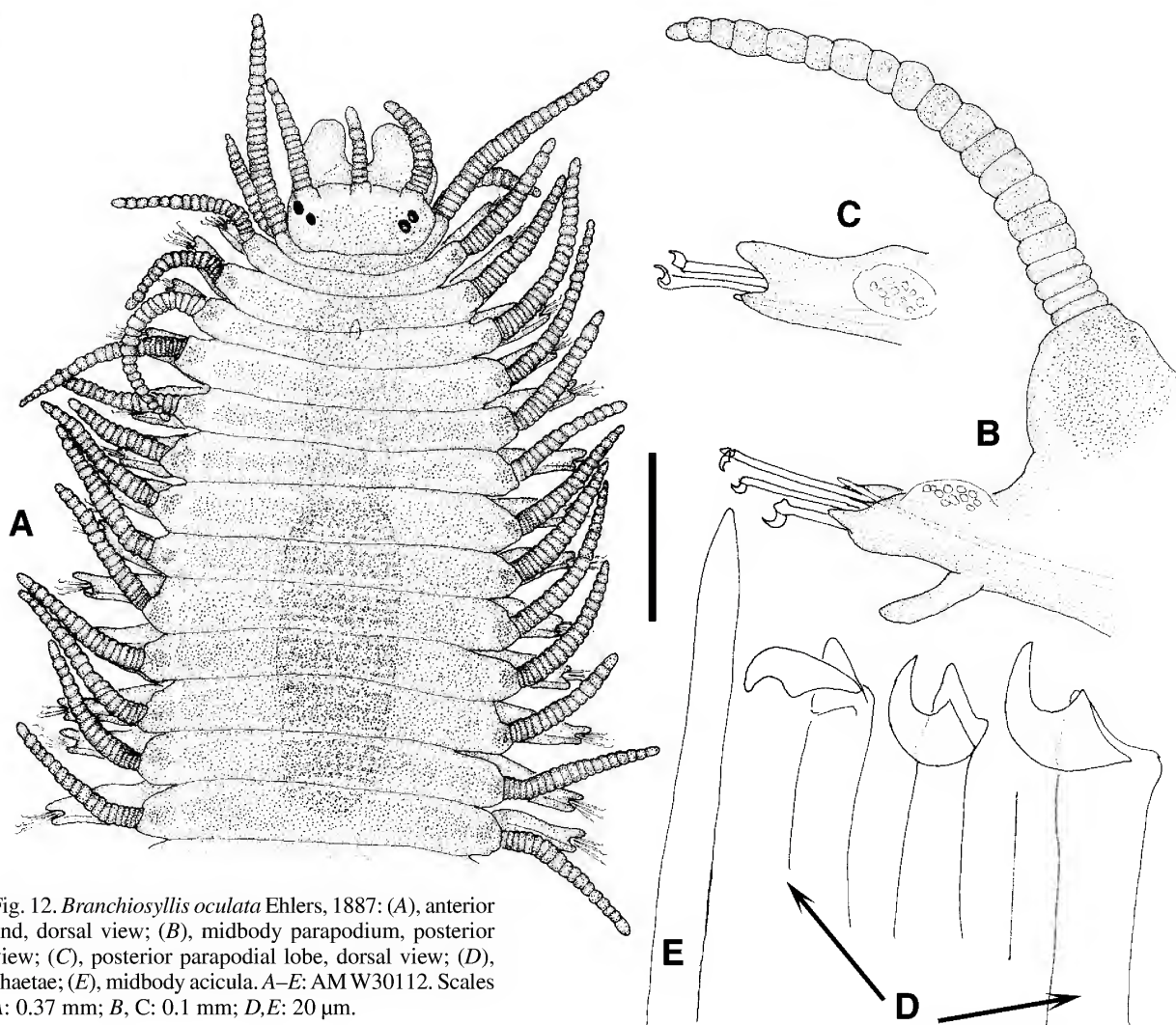


Fig. 12. *Branchiosyllis oculata* Ehlers, 1887: (A), anterior end, dorsal view; (B), midbody parapodium, posterior view; (C), posterior parapodial lobe, dorsal view; (D), chaetae; (E), midbody acicula. A–E: AM W30112. Scales A: 0.37 mm; B, C: 0.1 mm; D, E: 20 µm.

Branchiosyllis oculata Ehlers, 1887

Figs 12A–E, 13C–F, 15A

Branchiosyllis oculata Ehlers, 1887: 148, pl. 39, figs 1–7.—Rioja, 1958: 240, fig. 7.—Uebelacker, 1984: 30–107, fig. 30–102.—San Martín, 1991: 233.

Branchiosyllis pacifica australis Hartmann-Schröder, 1981: 23, figs 14–18.

Material examined. **Western Australia:** Kimberley region; reef S of Lucas Is., Brunswick Bay, 15°16'S 124°29'E, dead coral & *Sargassum* with heavy silt loading, 2 m, coll. P.A. Hutchings, 24 July 1988, 1 (AM W30112); SW corner of Lucas Is., 15°13'S 124°31'E, coral rubble, 2–30 m, coll. P.A. Hutchings, 24 July 1988, 2 (AM W30113); Bernouli Is., 15°S 124°47'E, sand with coral rubble, 1 m, coll. P.A. Hutchings, 12 July 1988, 8 (1 on SEM stub) (AM W30114).

Additional material examined. *Branchiosyllis oculata* NFMN 6745, 1 syntype, Key West, Florida, USA. *Branchiosyllis pacifica australis* HZM P-16474 (holotype), and HZM P-16475 (1 paratype), Exmouth, Tantabiddy Creek, Western Australia.

Description. Body long, strongly dorsoventrally flattened, ribbon-like (Figs 12A, 13C,D), longest examined specimen about 100 mm long, 0.8 mm wide, with 92 chaetigers plus developing sexual acephalous stolon of 11 chaetigers. Some specimens dark brown, with lighter areas, others colourless in alcohol. Prostomium oval; 4 small eyes in open trapezoidal arrangement. Antennae inserted near anterior margin

of prostomium (Figs 12A, 13D), proportionally short, with about 14 articles, all similar in length. Palps similar in length to prostomium. Nuchal organs not observed. Peristomium shorter than subsequent segments; dorsal tentacular cirri distinctly longer than antennae, with about 26 articles; ventral tentacular cirri about $\frac{2}{3}$ length of dorsal ones, with about 14 articles (Figs 12A, 13D). Parapodia elongate, distally bilobed, with prechaetal lobe longer than postchaetal lobe (Figs 12B,C, 13E); rounded, dome-shaped branchia dorsally located on parapodial lobe (Figs 12B,C, 13E,F, arrows), with granular appearance. Dorsal cirri with distinct, usually dark cirrophores (Fig. 12B), and 20–23 articles on midbody, alternating in length, but all shorter than body width. Ventral cirri digitiform, elongated, inserted near middle of parapodial lobe. All compound falcigers claw-shaped, with smooth, unidentate blades of varying sizes on each parapodium (Figs 12D, 13E, 15A); anterior parapodium with 4–6 compound chaetae, decreasing to 3 on midbody and posterior parapodia. Anterior parapodia with 2 aciculae, from proventricular segments onwards solitary acicula, straight, distally pointed (Fig. 12B,E), protruding from parapodial lobes (Figs 13E, 15A). Pharynx through about 6 segments; pharyngeal tooth on anterior margin. Proventricle rectangular, through 6–7 segments, with 26–30 muscle cell rows. Pygidium small, with 2 anal cirri similar to dorsal cirri.

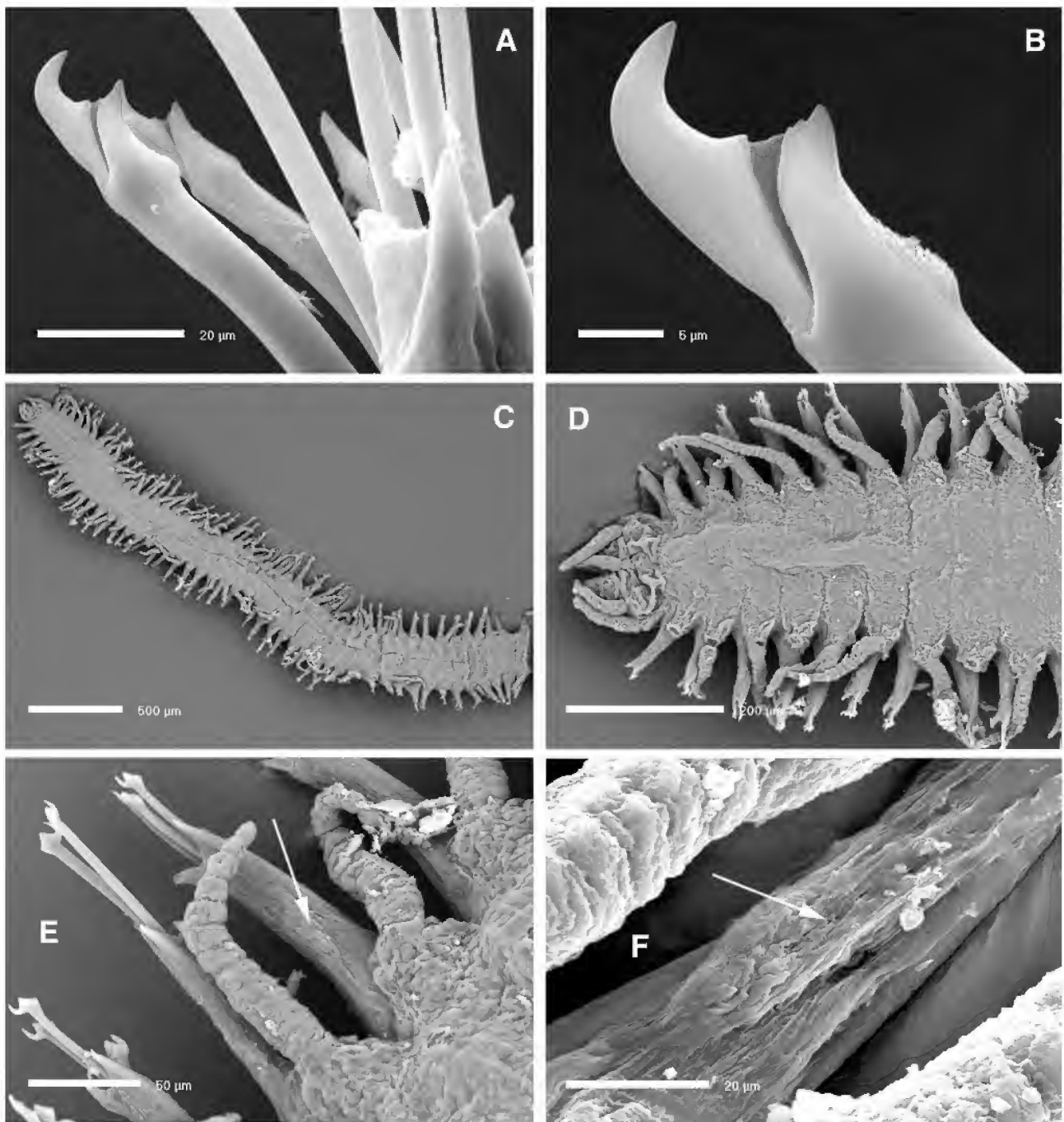


Fig. 13. SEM of *Branchiosyllis maculata* (Imajima, 1966): (A), ventral midbody chaetae and emerging aciculae; (B), ventral chaeta, midbody. SEM of *Branchiosyllis oculata* Ehlers, 1887: (C), complete specimen, dorsal view; (D), anterior end, dorsal view; (E), midbody parapodia, dorsal view; (F), detail of branchia. A–B: AM W30111; C–F: AM W30114.

Remarks. *Branchiosyllis oculata* is the type species of the genus, and was described from material collected in Florida, and has been widely reported from the Gulf of México and Caribbean region, from Cuba to Venezuela. The specimens from Western Australia agree with the description of this species and resemble the syntypes and specimens from Cuba and Venezuela, which have been examined, although the branchiae are smaller and less distinct in Australian specimens. This species belongs to the group of species with branchiae and all claw-shaped falcigers, with blades rotated 180°. *Branchiosyllis pacifica* Rioja, 1941, known from the Pacific coast of America, between México and Panamá also

belongs to this group (see Rioja, 1941, Capa *et al.*, 2001 a); in this species, the branchiae are better developed being either bi- or tri-lobed than in the type species. *Branchiosyllis pacifica australis* Hartmann-Schröder, 1981, described from Western Australia agrees with *Branchiosyllis oculata*, although the original description omitted mention of the presence of branchiae; however these are small and easily overlooked. Both, holotype and paratype of this subspecies are very small specimens, probably juveniles, and may lack branchiae or they are small and indistinct and we have therefore synonymized this subspecies with *Branchiosyllis oculata*.

Habitat. Shallow water in sand and coral rubble, algae and encrusting algae in surf zone.

Distribution. Gulf of México and Caribbean Sea, Australia (North Western Australia).

***Branchiosyllis orbiniiformis* n.sp.**

Figs 14A–C, 15B–F

Material examined. HOLOTYPE (AM W30115), PARATYPES, 2 (AM W30116), **Western Australia:** Kimberley region, reef S of Lucas Is., Brunswick Bay, 15°16'S 124°29'E, dead coral & *Sargassum* with heavy silt loading, 2 m, coll. P.A. Hutchings, 24 July 1988; Bernouli Is., 15°S 124°47'E, sand with coral rubble, intertidal, coll. P.A. Hutchings, 12 July 1988, 2 (AM W30117); SW corner of Lucas Is., 15°13'S 124°31'E, dead coral rubble & silt, 2–30 m, coll. P.A. Hutchings, 24 July 1988, 2 (1 on SEM stub) (AM W26512).

Description. Body distinctly compressed laterally, with cirri and parapodia dorsally directed (Figs 14A, 15B–D); usually colourless, but some specimens with 1–2 dark spots on cirrophores; one specimen with black spots on dorsum as well. Holotype 3.6 mm long, 0.48 mm wide, with 38 chaetigers; longest paratype 5 mm long, with 57 chaetigers. Prostomium small, oval; 4 small eyes in open trapezoidal arrangement. Median antenna inserted in front of anterior eyes, with about 13–14 articles, slightly shorter than combined length of prostomium and palps; lateral antennae shorter than median antenna, with about 10 articles, inserted near anterior margin of prostomium. Nuchal organs not observed. Peristomium shorter than subsequent segments, dorsally reduced, covered by chaetiger 1; dorsal tentacular cirri longer than antennae, with about 17–19 articles; ventral tentacular cirri approximately half of length of dorsal ones, with about 8 articles. Parapodia directed dorsally, elongated, extending beyond dorsum (Figs 14A, 15A–D); in lateral view, dorsal cirri dorsally directed, longer than width of anterior segments, with about 11–16 articles, irregular in length, some segments with unequal dorsal cirri, becoming shorter from midbody (Fig. 14A). Parapodial lobes elongate, distally blunt, without branchiae (Fig. 15C,D). Ventral cirri distinctly short, papilliform (Fig. 14A). Aciculae strong basally, distally pointed (Figs 14A,C, 15E), supporting parapodial lobes dorsally directed; 2 aciculae in anterior parapodia, single in remaining segments. All parapodia with 3 compound falciger, blades unidentate, marginally smooth, claw-shaped, with blades turned 180° (Figs 14B, 15E,F); dorsal falcigers with slender shafts and short blades, becoming thicker ventrally, with larger blades. Pharynx through 6–7 segments; pharyngeal tooth anteriorly located (Fig. 14A). Proventricle barrel-shaped, through 6 segments, with 24–27 muscle cell rows. Pygidium small, with 2 anal cirri, similar to dorsal ones.

Remarks. *Branchiosyllis orbiniiformis* n.sp., is unique among all syllids in having a combination of distinctly laterally compressed body, with parapodia, chaetae and dorsal cirri all dorsally directed. Specimens of this species superficially look

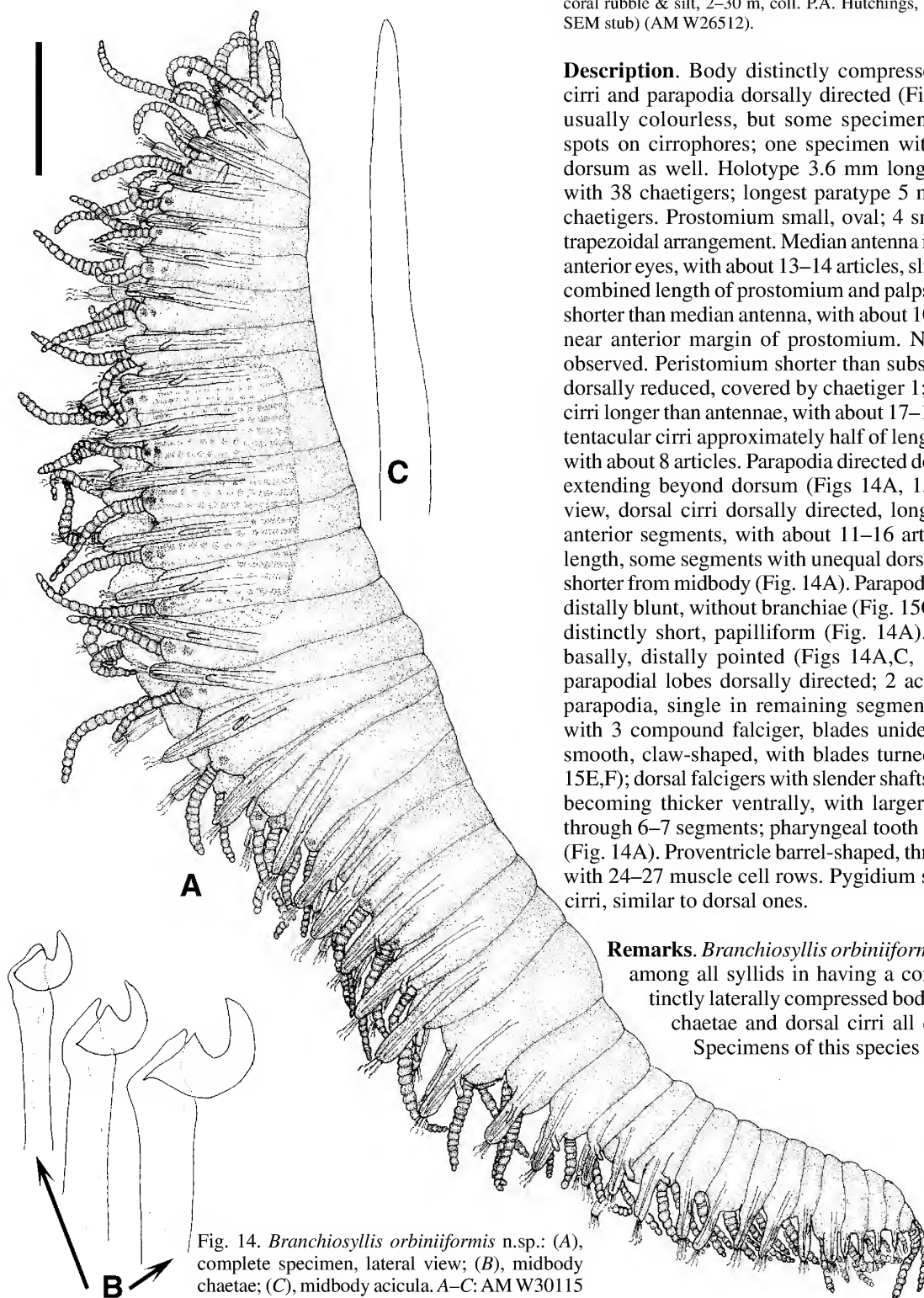


Fig. 14. *Branchiosyllis orbiniiformis* n.sp.: (A), complete specimen, lateral view; (B), midbody chaetae; (C), midbody acicula. A–C: AM W30115 (holotype). Scales A: 0.1 mm; B, C: 20 μ m.

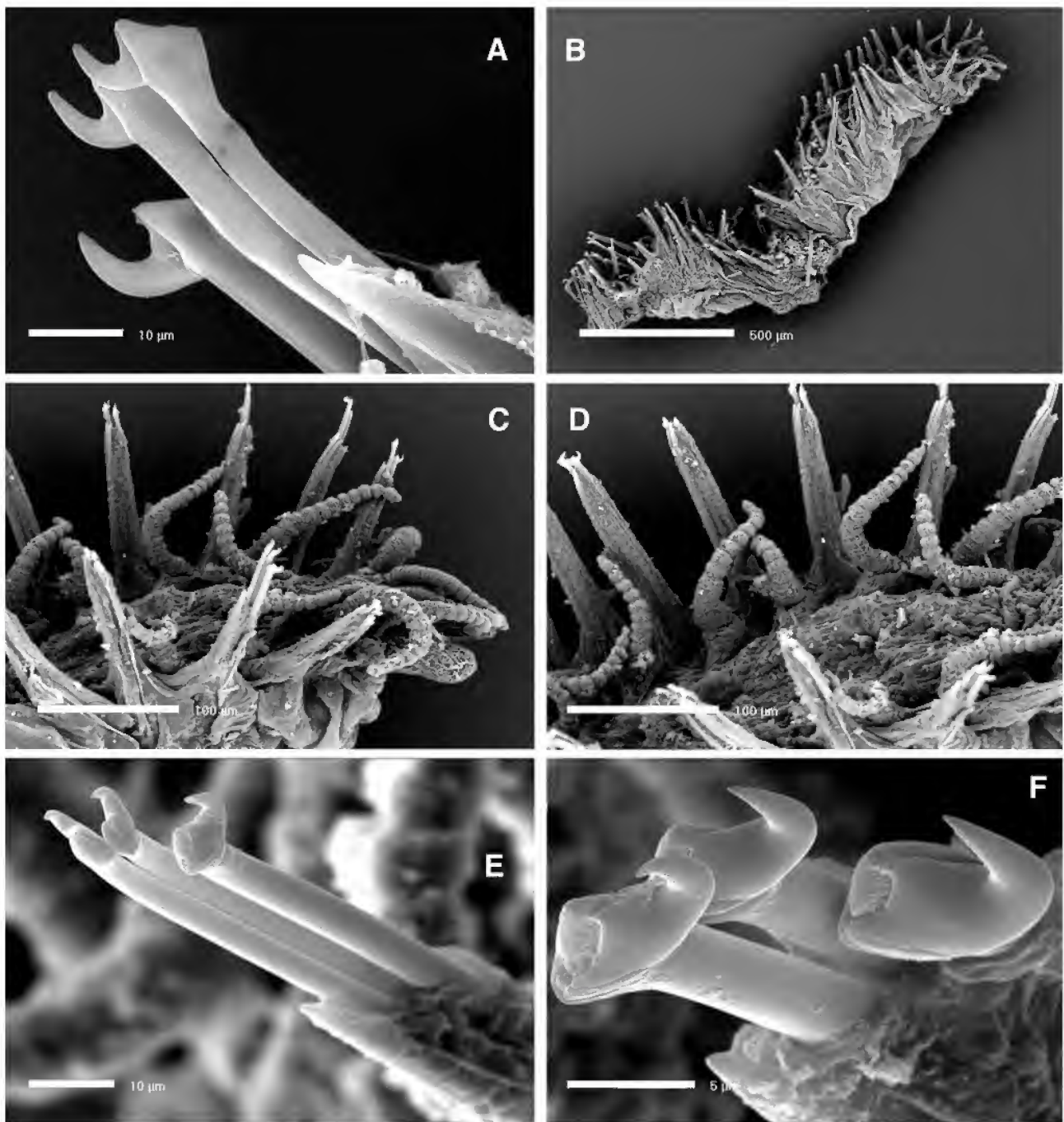


Fig. 15. SEM of *Branchiosyllis oculata* Ehlers, 1887: (A), chaetae and emerging acicula. SEM of *Branchiosyllis orbiniiformis* n.sp.: (B), complete specimen; (C), anterior end, laterodorsal view; (D), midbody, dorsal view; (E,F), anterior chaetae. A: AM W30114; B–F: AM W26512.

like a small orbiniid, but a more detailed examination reveals their familial association. The compound chaetae are typical of the genus *Branchiosyllis*.

Etymology. The specific name refers to the superficial resemblance between members of this species and members of the family Orbiniidae (Polychaeta).

Habitat. Occurs in 2–30 m, in dead coral substrate often heavily loaded with silt and *Sargassum*.

Distribution. Australia (North Western Australia).

Branchiosyllis thylacine n.sp.

Fig. 16A–G

Material examined. HOLOTYPE (AM W30120), PARATYPES 2 (AM W30121), **New South Wales:** 50 m west of Split Solitary Is., 30°14'S 153°10'48"E, *Herdmania momus*, rocks, sponges and ascidians, 16 m, coll. P.A. Hutchings & C.L. Rose, 7 Mar. 1992; N side of Bannister Head, 35°19'09"S 150°29'07"E, grey sponge from top of boulder, 18 m, coll. K. Attwood, 6 May 1997, 1 (AM W30122); Manta Reef, North West Solitary Is., 30°01'30"S 153°16'30"E, lace bryozoan, 19 m, coll. R.T. Springthorpe, 25 June 1992, 2 (AM W30123).

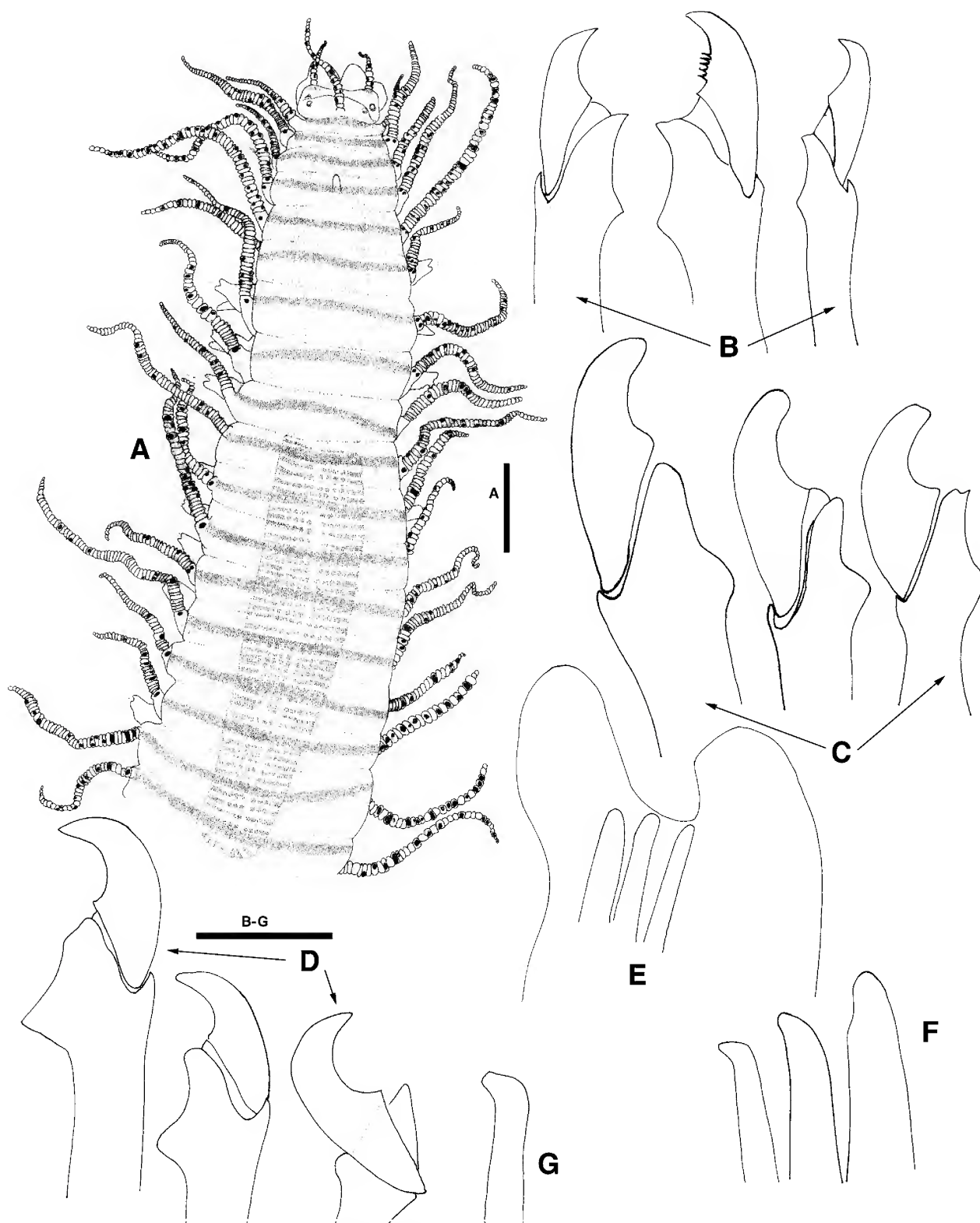


Fig. 16. *Branchiosyllis thylacine* n.sp.: (A), anterior end, dorsal view; (B), anterior chaetae; (C), midbody chaetae; (D), posterior chaetae; (E), midbody aciculae, with distal end of parapodial lobe; (F), anterior aciculae; (G), posterior acicula. A–G: AM W30120 (holotype). Scales A: 0.4 mm; B–G: 2 µm.

Description. Longest specimen examined 18 mm long, 1 mm wide, with 87 chaetigers, plus an attached stolon, 23 mm long, with 16 chaetigers; holotype 18 mm long, 1.52 mm wide, with about 100 chaetigers. Body cylindrical dorsally. Dorsum of each segment with single transverse

band of black pigment, black spots on numerous articles of dorsal cirri (Fig. 16A); ventrum with scattered, black dots. Prostomium rectangular, slightly bilobed; 4 eyes on trapezoidal arrangement, with shallow transverse furrow and 2 anterior pigmented lines (Fig. 16A). Median antenna

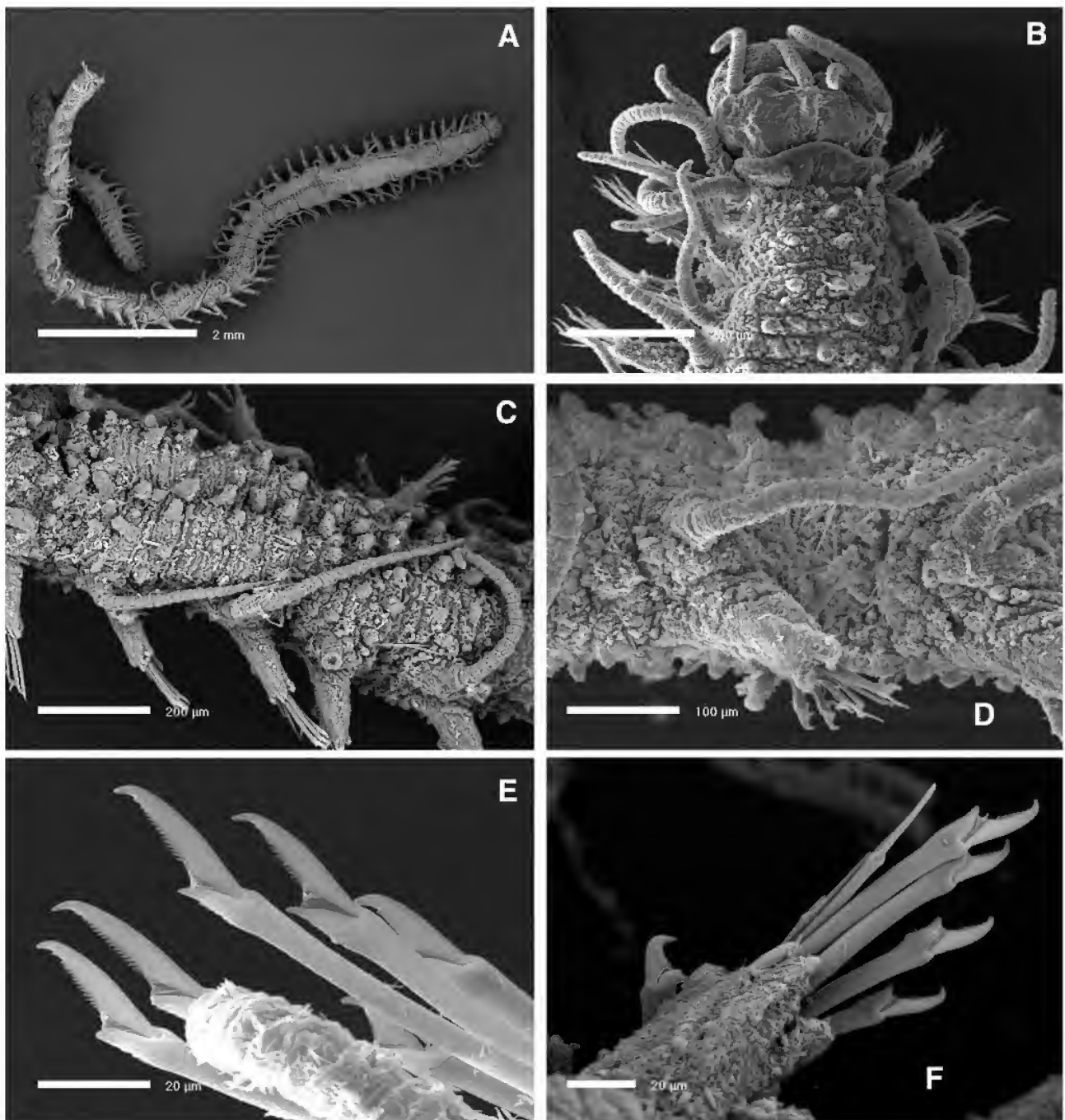


Fig. 17. SEM of *Branchiosyllis verruculosa* (Augener, 1913): (A), complete specimen (2 pieces), dorsal view; (B), anterior end, dorsal view; (C), midbody, dorsal view; (D), midbody parapodium; (E), anterior chaetal fascicle; (F), midbody chaetal fascicle, with emergent acicula. A–F: AM W30130.

slightly longer than combined length of prostomium and palps, inserted between posterior eyes, with 20–28 articles; lateral antennae inserted on anterior margin of prostomium, shorter than median antenna, with 13–18 articles. Palps similar in length to prostomium, wider basally, slightly bilobed. Nuchal organs not observed. Peristomium shorter than subsequent segments (Fig. 16A); dorsal tentacular cirri longer than median antenna, with 30–33 articles, ventral ones shorter than dorsal tentacular cirri, with 13–18 articles. Dorsal cirri with distinct, long cirrophore, pigmented black, often with single large black spot near cirrophore. Dorsal cirri of chaetiger 1 long, with 40–50 articles; subsequent dorsal

cirri alternating long and short (Fig. 16A), with up to 40 and 30 articles respectively, 29–42 on midbody. Parapodial lobes distally bilobed, prechaetal and postchaetal lobes digitiform, dissimilar in length (Fig. 16A,E). Ventral cirri digitiform, shorter than parapodial lobes. Usually 3 compound heterogomph chaetae on anterior parapodia (occasionally up to 5), blades falcigerous, unidentate, with short spines on margin or totally smooth (Fig. 16B), blades 27–28 µm above, 21 µm below. In more posterior parapodia, shafts becoming larger, with marked subdistal spurs, especially on ventral chaetae (Fig. 16C); on far posterior parapodia, blades of ventralmost chaetae rotated 180°, becoming claw-shaped; remaining

two falcigers with markedly larger shafts with subdistal spurs, and hooked blades (Fig. 16D), about 28–29 µm long. Anterior parapodia each with 3 slender aciculae (Fig. 16E), 1 straight and others slightly oblique at tip (Fig. 16F); from midbody posteriorly, number of aciculae per parapodium decreasing, posterior parapodia with single aciculum, slightly oblique at tip (Fig. 16G). Pharynx through about 7 segments; pharyngeal tooth located anteriorly, surrounded by crown of 10 soft papillae. Proventricle longer than pharynx, through 9 segments, with about 40–50 muscle cell rows. Pygidium small, with 2 anal cirri similar to dorsal cirri. Two specimens with attached acephalous stolon.

Remarks. Haswell (1886) described, a species with similar colour pattern from New South Wales, *Gnathosyllis zonata* Haswell, 1886, considered by Licher (1999), perhaps erroneously, as a synonym of *Syllis prolifera* Khron, 1852. However, descriptions of Australian material of that species by Haswell (1886) and Augener (1913) differ from this new species in having distinctly bidentate chaetae and, apparently, lacking claw-shaped chaetae. Haswell's original description was based on a single, incomplete specimen, so the posterior chaetae were not described; and he noted that up to 10 chaetae were present per parapodium, whereas our species has only five. The type of *G. zonata* cannot be located and is presumed lost.

Etymology. The species is named after the Tasmanian wolf, also known as Tasmanian tiger, *Thylacinus cynocephalus*, a carnivorous marsupial, which also has stripes on its back. Used as a noun in apposition.

Habitat. Found in depths of 16–19 m in amongst sponges, ascidians or bryozoans.

Distribution. Australia (New South Wales).

Branchiosyllis verruculosa (Augener, 1913)

Figs 17A–F, 18A–F, 19A–D

Syllis (*Typosyllis*) *verruculosa* Augener, 1913: 203, text-fig.

24a–c, pl. 3, fig. 39.–Day & Hutchings, 1979: 104.

Syllis verruculosa Monro, 1939: 29, text-fig. 298.

Branchiosyllis verruculosa Licher, 1999: 274.–Aguado *et al.*, 2008: 13, fig. 5.

Material examined. **Western Australia:** inshore reef off Neds Camp, Cape Range National Park, 21°59'S 113°59'E, in *Caulerpa* sp., intertidal, coll. J.K. Lowry, 2 Jan. 1984, 1 (AM W30124); Goss Passage, Beacon Is., 28°25'30"S 113°47'E, dead plates of *Acropora* sp. covered in coralline algae, 20 m, coll. P.A. Hutchings, 20 May 1994, 1 (AM W30125); Goss Passage, Beacon Is., 28°25'30"S 113°47'E, dead plates of *Acropora* sp. covered in coralline algae & sponges, 32 m, coll. P.A. Hutchings, 19 May 1994, 1 (AM W30126); Goss Passage, Beacon Is., 28°25'30"S 113°47'E, dead plates of *Acropora* sp. covered in coralline algae, 8 m, coll. P.A. Hutchings, 22 May 1994, 1 (AM W30127); Goss Passage, Beacon Is., 28°25'30"S 113°47'E, dead coral substrate embedded in fine sediment, 33 m, coll. P.A. Hutchings, 23 May 1994, 1 (on SEM stub), (AM W30130); E side of West Wallabi Is., 28°27'54"S 113°40'54"E, in *Posidonia australis* root mat plus epifauna, 2 m, coll. P.A. Hutchings, 26 May 1994, 1 (AM W30128); SE end of Long Is., 28°28'48"S 113°46'30"E, dead coral substrate embedded in calcareous substrate, 30 m, coll. P.A. Hutchings, 22 May 1994, 2 (AM W30129). **South Australia:** Billy Lights Point, Port Lincoln, 34°45'S 135°53'E, stone washings from sheltered intertidal rocks, coll. I. Loch, 15 Feb. 1985, 1 (AM W30131). **Queensland:** Triangular Islets, Shoalwater Bay, 22°23'S 150°30'E, coll. J.A. Lewis & J.R. Forsyth, 1981, 3 (AM W202642).

Additional material examined. **Western Australia:** Shark Bay, 25°30'S 113°40'E, 3–8 m, ZMB5296, 7 syntypes; ZMB 5297, 4 syntypes.

Description. Longest specimen examined 19 mm long, 0.6 mm wide, with 78 chaetigers plus small sexual acephalous stolon of few chaetigers. Body cylindrical in dorsal view (Figs 17A, 18A). Dorsum with irregular black pigment, forming transverse bands on some anterior segments (Fig. 18A); most of specimens with few, scattered papillae present laterally on each segment, more densely distributed posterior to proventricle (Figs 17A–D, 18A); large specimens with distinct papillae from anterior segments onwards, and papillae also on ventrum. Prostomium oval, large (Figs 17B, 18A), 4 black eyes in open trapezoidal arrangement, anterior and posterior ones on each side nearly vertically aligned (Fig. 18A). Median antenna slightly shorter than combined length of prostomium and palps, inserted in front of line between anterior eyes, with 16–17 articles; lateral antennae inserted near anterior margin of prostomium, shorter than median antenna, with 14–16 articles. Palps similar in length to prostomium or shorter. Nuchal organs not observed. Peristomium shorter than subsequent segments (Figs 17B, 18A); dorsal tentacular cirri longer than median antenna, ventral ones shorter than dorsal tentacular cirri. Dorsal cirri of chaetiger 1 long, with about 37 articles; those of chaetigers 2 and 3 shorter, with about 15 and 19 articles respectively, dorsal cirri of chaetiger 4 long, with about 34 articles; remaining dorsal cirri alternating long and short, with 17–20 and 11–14 articles respectively. Parapodial lobes conical, distally bilobed, prechaetal and postchaetal lobes dissimilar (Fig. 18A). Ventral cirri digitiform, shorter than parapodial lobes. Anterior parapodia with 5–6 compound heterogomph chaetae, blades falcigerous, unidentate or minutely bidentate (Figs 17E, 18B), with short spines on margin on dorsal chaetae to smooth on ventral ones, blades 27 µm above, 17–18 µm below. In midbody, 5–6 compound chaetae per parapodium, similar to anterior ones, but shorter, hooked, and smooth (Figs 17F, 18D). Some blades becoming claw-shaped posteriorly, with blades rotated 180°; number of claw-shaped falcigers increasing and non-modified falcigers decreasing posteriorly (Fig. 19A,B); posterior parapodia with 4–5 claw-shaped falcigers, all similar or differing slightly in size (Figs 17C,D, 18E, 19C,D). Anterior parapodia each with 2 slender aciculae, 1 straight and other slightly oblique at tip (Fig. 18C); from midbody onwards, single acicula per parapodium, thicker than anterior ones, slightly oblique at tip (Fig. 18F), protruding from parapodial lobes (Fig. 17F). Pharynx through 5–6 segments; pharyngeal tooth located anteriorly (Fig. 18A). Proventricle similar in length to pharynx, through 5–7 segments, with about 30 muscle cell rows. Pygidium small, with 2 anal cirri similar to dorsal cirri.

Remarks. *Branchiosyllis verruculosa* is similar to *B. exilis*, but differs in having all chaetae unidentate or minutely bidentate anteriorly, and with some papillae present on the dorsum. This is the only species of the genus described with papillated dorsum. The studied material agrees well with the types and previous description as well as the Indonesian specimens.

Habitat. Occurs from intertidal to 33 m, under rocks intertidally or associated with dead coral substrate covered in coralline algae.

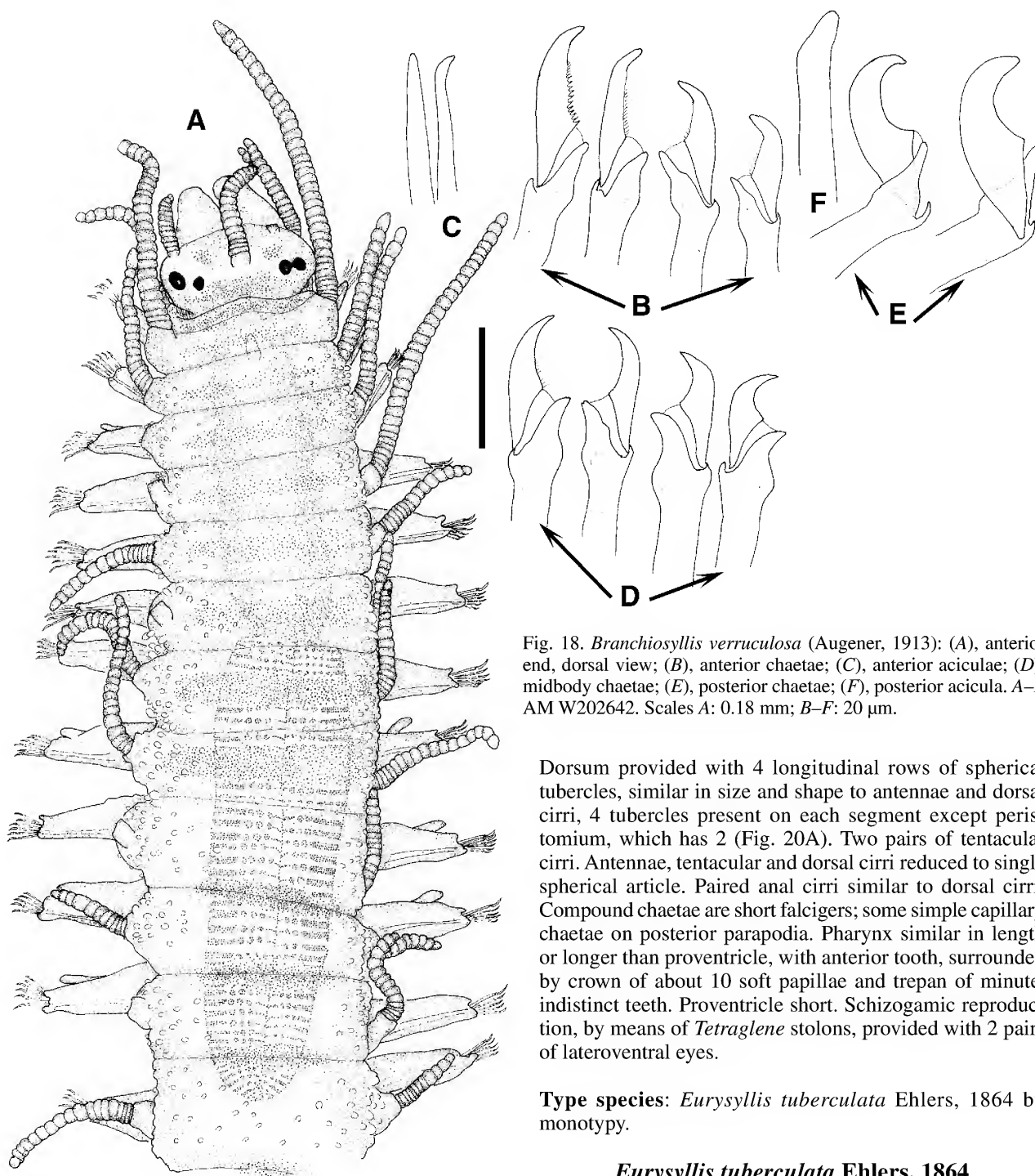


Fig. 18. *Branchiosyllis verruculosa* (Augener, 1913): (A), anterior end, dorsal view; (B), anterior chaetae; (C), anterior aciculae; (D), midbody chaetae; (E), posterior chaetae; (F), posterior acicula. A–F AM W202642. Scales A: 0.18 mm; B–F: 20 μ m.

Dorsum provided with 4 longitudinal rows of spherical tubercles, similar in size and shape to antennae and dorsal cirri, 4 tubercles present on each segment except peristomium, which has 2 (Fig. 20A). Two pairs of tentacular cirri. Antennae, tentacular and dorsal cirri reduced to single spherical article. Paired anal cirri similar to dorsal cirri. Compound chaetae are short falcigers; some simple capillary chaetae on posterior parapodia. Pharynx similar in length or longer than proventricle, with anterior tooth, surrounded by crown of about 10 soft papillae and trepan of minute, indistinct teeth. Proventricle short. Schizogamic reproduction, by means of *Tetraglene* stolons, provided with 2 pairs of lateroventral eyes.

Type species: *Eurysyllis tuberculata* Ehlers, 1864 by monotypy.

Eurysyllis tuberculata Ehlers, 1864

Fig. 20A–E

Eurysyllis tuberculata Ehlers, 1864: 264, figs 4–7.—Laubier, 1968: 94, figs 7, 8.—Hartmann-Schröder, 1982: 66; 1984: 21; 1987: 39; 1989: 27.—Uebelacker, 1984: 30–99, fig. 30–94.—San Martín, 2003: 296, figs 162–164.

Material examined. Western Australia: Kimberley region, reef S of Lucas Is., Brunswick Bay, 15°16'S 124°29'E, 24 July 1988, dead coral & *Sargassum* with heavy silt loading, 2 m, coll. P.A. Hutchings, 6 (on SEM stub) (AM W30132); Lafontaine Is., 14°10'S 125°47'E, found underneath dead coral colonies on muddy substrate, 9–15 m, coll. P.A. Hutchings, 19 July 1988, 1 (on SEM stub) (AM W30133); Bernouli Is., 15°S 124°47'E, underneath rocks, intertidal, coll. P.A. Hutchings, 12 July 1988, 1 (AM

Distribution. Australia (Central Western Australia, South Australia, Queensland), Indonesia.

Genus *Eurysyllis* Ehlers, 1864

Eurysyllis Ehlers, 1864: 264.

Diagnosis. Body small, oval, elongated, strongly flattened dorsoventrally. Prostomium with 2 pairs of eyes, 3 antennae and 2 spherical palps. Antennae inserted on anterior margin of prostomium; palps inserted ventrally, fused to each other.

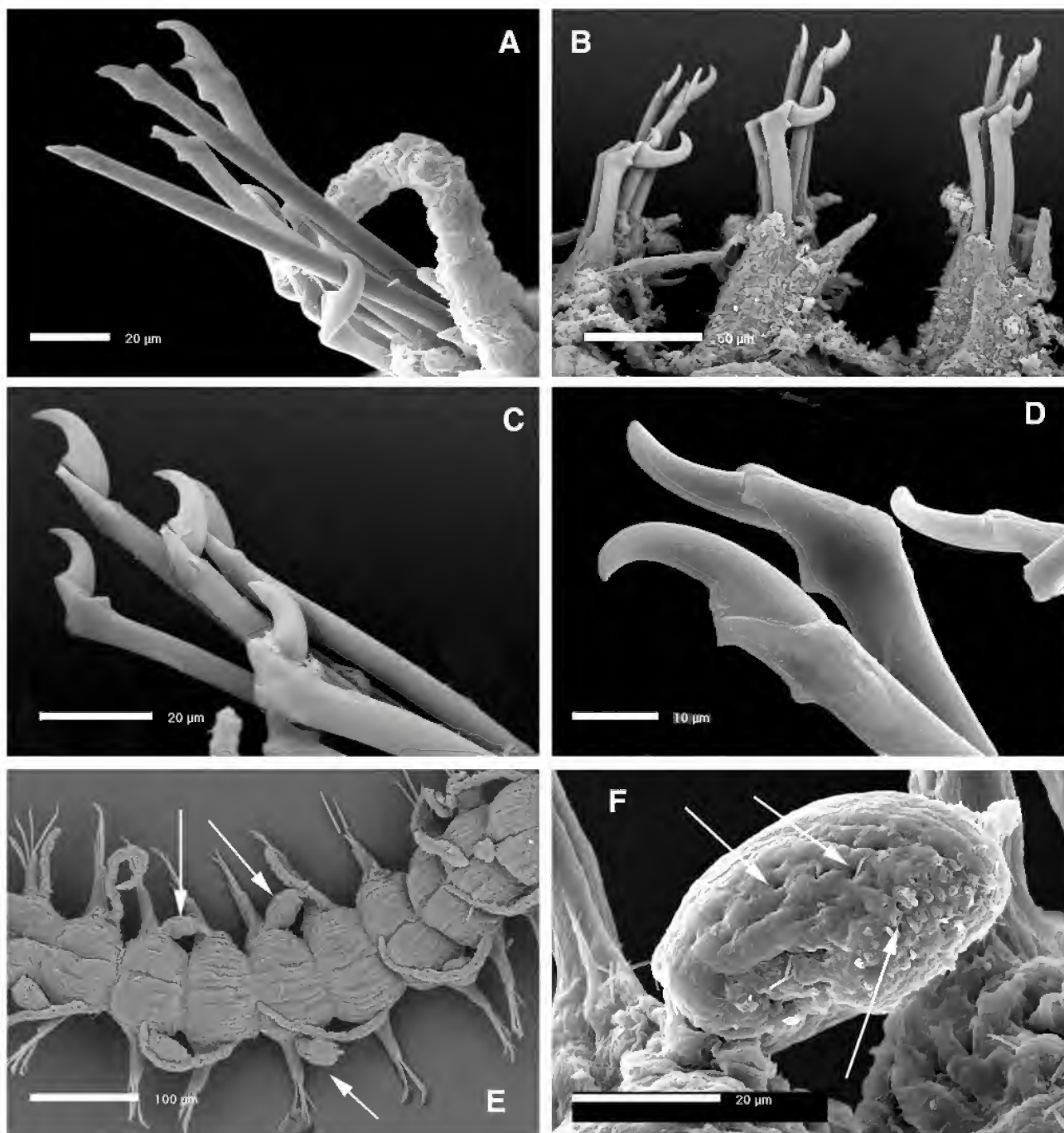


Fig. 19. SEM of *Branchiosyllis verruculosa* (Augener, 1913): (A,B), mid-posterior chaetal fascicles; (C,D), posterior chaetae. SEM of *Paraphaerosyllis indica* Monro, 1937: (E), midbody, dorsal view; (F), reduced dorsal cirrus, midbody. A–D: AM W30130; E–F: AM W30153.

W30134); SW corner of Lucas Is., 15°13'S 124°31'E, dead coral substrate with heavy silt loading, 2–30 m, coll. P.A. Hutchings, 24 July 1988, 1 (AM W30140); Lafontaine Is., 14°10'S 125°47'E, soft substrate with isolated dead coral colonies & sponges, 15 m, coll. P.A. Hutchings, 19 July 1988, 2 (AM W30141); Houtman Abrohlos, off jetty adjacent to Fisheries Hut, Beacon Is., 28°25'30"S 113°47'E, dead coral substrates, plate-like *Acropora* & *Montipora* spp., 12 m, coll. P.A. Hutchings, 23 May 1994, 2 (AM W30135); Goss Passage, Beacon Is., 28°25'30"S 113°47'E, dead plates of *Acropora* sp., covered in coralline algae & sponges, 32 m, coll. P.A. Hutchings, 19 May 1994, 1 (AM W30136); SE end of Long Is., 28°28'48"S 113°46'30"E, dead coral substrate covered in coralline algae, 8 m, coll. P.A. Hutchings, 22 May 1994, 2 (AM W30137); N end of Long Is., Goss Passage, 28°27'54"S 113°46'18"E, dead coral substrate with coralline & brown algae, 6 m, coll. C. Bryce, 22 May 1994, 1 (AM W30138); NE entrance to Goss Passage, Beacon Is., 28°27'54"S 113°46'42"E, dead branching staghorn *Acropora* sp. with coralline & brown algae, 24 m, coll. P.A. Hutchings, 25 May 1994, 1

(AM W30139); Goss Passage, Beacon Is., 28°25'30"S 113°47'E, dead plates of *Acropora* sp. covered in coralline algae, 8 m, coll. P.A. Hutchings, 22 May 1994, 1 (AM W30142); N end of Long Is., Goss Passage, 28°27'54"S 113°46'18"E, dead coral substrate covered in coralline & brown algae, 6 m, coll. C. Bryce, 22 May 1994, 1 (AM W30143); Reef W of groyne, 2 km S of Cape Peron, 32°16'S 115°41'E, orange sponge, 4.5 m, coll. R.T. Springthorpe, 26 Dec. 1983, 3 (AM W26788). **South Australia:** Billy Lights Point, Port Lincoln, 34°45'S 135°53'E, stone washings from sheltered intertidal rocks, coll. I. Loch, 15 Feb. 1985, 3 (AM W26710). **New South Wales:** 100 m NW of Julian Rocks, Byron Bay, 28°36'48"S 153°37'48"E, shell and gravel, 15 m, coll. G.D.F. Wilson, R.T. Springthorpe & L. Albertson, 3 Mar. 1992, 1 (AM W30146); 100 m NW of Julian Rocks, Byron Bay, 28°36'48"S 153°37'48"E, shell & gravel, 15 m, coll. G.D.F. Wilson, R.T. Springthorpe & L. Albertson, 3 Mar. 1992, 1 (AM W30147). **Tasman Sea:** reef flat near "Yoshin Maru Iwaki" wreck, Elizabeth Reef, 29°55'48"S 159°01'18"E, from small heads of *Acropora valida*, *Pocillopora*

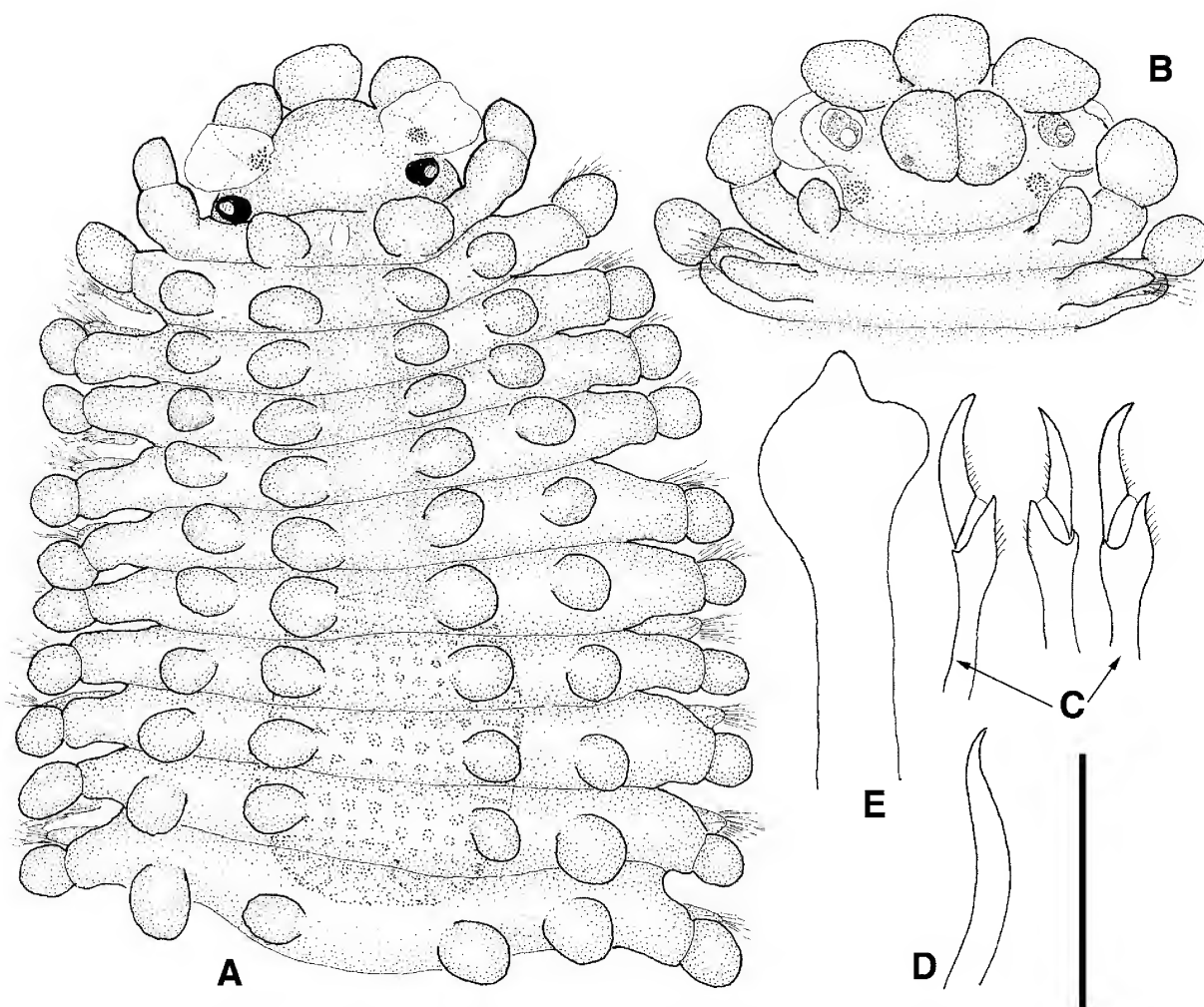


Fig. 20. *Eurysyllis tuberculata* Ehlers, 1864: (A), anterior end, dorsal view; (B), anterior end, ventral view; (C), compound chaetae; (D), ventral simple chaeta; (E), acicula. A–E: AM W30132. Scales A,B: 0.18 mm; C–E: 20 μ m.

damicornis, intertidal, coll. J.K. Lowry & R.T. Springthorpe, 14 Dec. 1987, 2 (AM W30144); Taupo Seamount, 33°16'51"S 156°09'09"E, 244 m, coll. J.K. Lowry on RV "Franklin", 2 May 1989, 3 (AM W30145).

Additional material examined. *Eurysyllis tuberculata*. SPAIN: Mediterranean: Islas Columbretes, Castellón, 39°54'02"N 00°41'15"E, 47 m, 12 July 1994, 2 (MNCN 16.01/6553); Balearic Is. Punta Jova, W Mallorca, 39°38'50"N 02°25'13"E, 10 m, 24 June 1994, 9 (MNCN 16.01/6554); Cabo Pino, Málaga, 6 (MNCN 16.01/178); Atlantic Ocean, Banco de Galicia, 42°42'37"–42°43'00"N to 11°47'87"–11°45'78"E, 769–760 m, 28 June 1991, 1 (MNCN 16.01/6552).

Description. Longest specimen examined, 4.5 mm long, 0.35 mm wide, with 56 chaetigers plus stolon of about 20 chaetigers. Body ovate-elongated, dorsoventrally flattened, without colour markings. Dorsum of each segment provided with 4 rounded tubercles, sometimes distally pointed, forming 4 longitudinal rows of tubercles; peristomium with only 2 dorsal tubercles (Fig. 20A). Prostomium triangular; posterior eyes located dorsally near posterior margin of prostomium; anterior eyes located ventrally near anterior margin, eyespots also located ventrally, near palps. Three spherical, short antennae on anterior margin of prostomium; 2 dorsolateral lobes, sometimes difficult to see, close to lateral antennae, similar in size and shape to antennae (Fig. 20A). Palps ventrally folded, spherical, fused all along their length, with median groove (Fig. 20B). Nuchal organs not

observed. Peristomium shorter than subsequent segments; dorsal tentacular cirri spherical, similar in size to antennae; ventral tentacular cirri smaller than dorsal ones, only visible ventrally. Segments numerous and short; cirrophores well developed; dorsal cirri with single article, spherical, small, similar in size and shape to antennae and tentacular cirri (Fig. 20A). Ventral cirri triangular. Compound chaetae heterogomph falcigers; shafts distally spinose, blades short, falcate, unidentate, with short spines on margin or almost smooth (Fig. 20C), about 10–11 μ m long; anterior parapodia with 10–12 compound falcigers, decreasing posteriorly to 4–5. Dorsal simple chaetae absent. Ventral simple chaetae sigmoid, smooth, unidentate (Fig. 20D), present on most posterior parapodia. Acicula solitary, large, distally expanded, with distal, short tip (Fig. 20E). Pharynx slender, proportionally long, through 7–9 segments. Proventricle short, ovoid, through 3–4 segments, with about 16 muscle cell rows. Stolons with eyes located ventrally.

Remarks. There are only three other species recognized in this genus: *E. pacificum* (Hartman, 1954) from Marshall Is., *E. spicum* Kudenov & Harris, 1995, from California, USA, and *E. japonicum* Imajima, 2003, from Japan. *Eurysyllis spicum* and *E. japonicum* differ from *Eurysyllis tuberculata* in the shape of the aciculae and in details of the compound

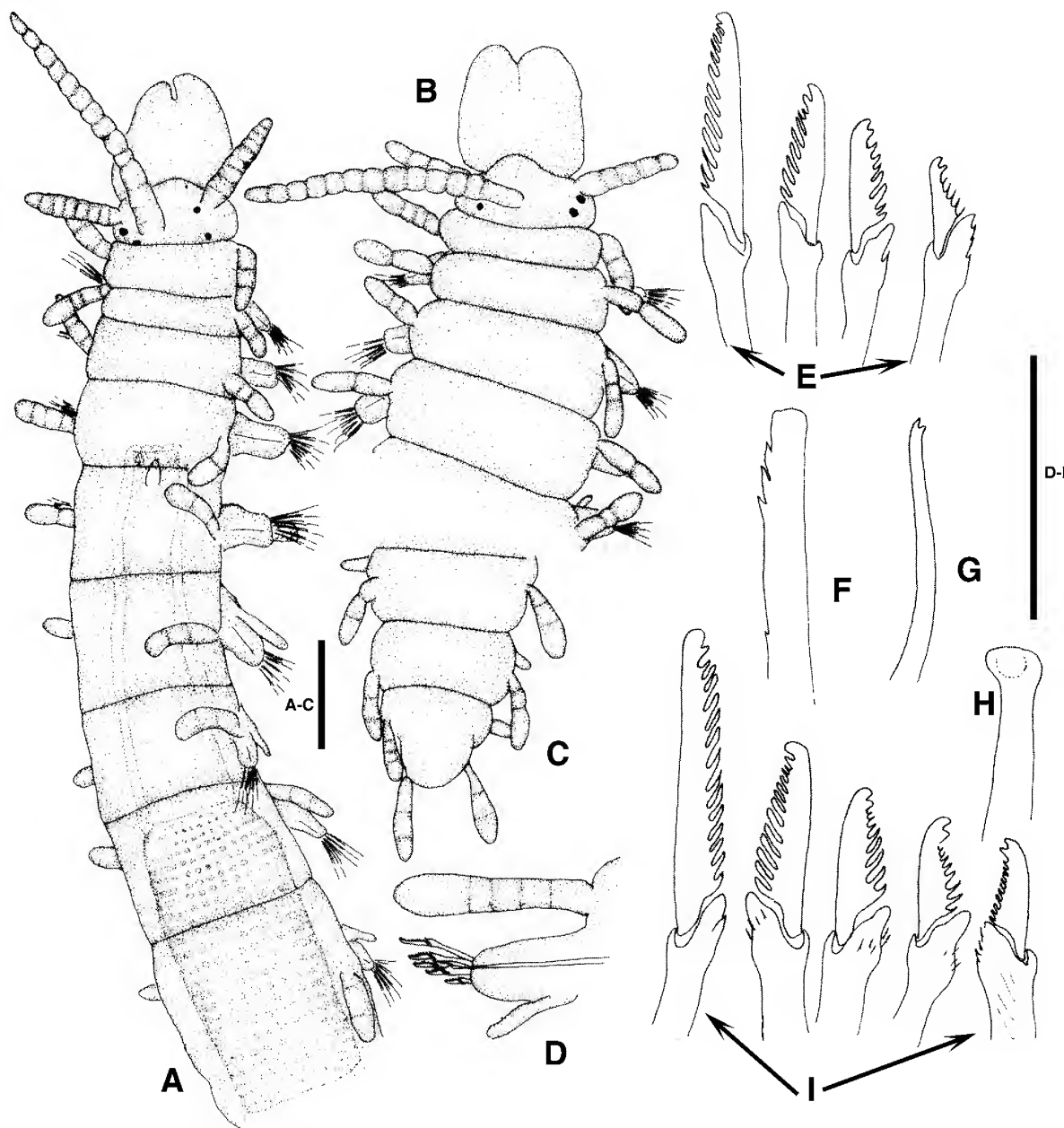


Fig. 21. *Karroonsyllis exogoneformis* San Martín & López, 2003; (A,B), anterior end, dorsal view; (C), posterior end, dorsal view; (D), midbody parapodium; (E), anterior compound chaetae; (F), dorsal simple chaeta; (G), ventral simple chaeta; (H), acicula; (I), posterior compound chaetae. All figures after San Martín & López, 2003. Scales A–C: 0.1 mm; D: 50 µm; E–I: 20 µm.

chaetae (see Hartman, 1954; Kudenov & Harris, 1995; Imajima, 2003); *E. pacificum* needs revision, as it was poorly described, and it appears to be similar to *E. tuberculata*.

Habitat. Occurs from intertidal to 30 m, often associated with dead coral substrate, encrusted with algae or sponges.

Distribution. Australia (North and Central Western Australia, South Australia, Tasman Sea, New South Wales), Mediterranean, Red Sea, Eastern Atlantic from North Sea to Canary Islands and Western Atlantic from North Carolina (USA) to Gulf of México.

Genus *Karroonsyllis* San Martín & López, 2003

Karroonsyllis San Martín & López, 2003: 192.

Diagnosis. Body small (in meiofaunal size range), slender, cylindrical, with numerous segments. Prostomium with 2 pairs of eyes and paired anterior ocular spots; 3 articulated antennae. Palps long and broad, fused along their entire length, except for terminal notch. Tentacular segment similar to following ones, with 1 pair of articulated tentacular cirri; nuchal organs as ciliated grooves in ventrolateral position. Segments without ciliary bands. Dorsal cirri on all segments, articulated, each with few articles. Parapodia each with

several compound chaetae, and simple dorsal and ventral capillary chaetae on posterior parapodia. Two anal cirri, similar to dorsal cirri. Pharynx similar in length or longer than proventricle, with single dorsal, conical tooth and crown of soft papillae.

Type species. *Karroosyllis exogoneformis* San Martín & López, 2003 by monotypy.

***Karroosyllis exogoneformis*
San Martín & López, 2003**

Fig. 21A–I

Karroosyllis exogoneformis San Martín & López, 2003:
192, figs 1–3.

Material examined. Western Australia: Houtman Abrohlos, SE end of Long Is., Goss Passage, 28°28'48"S 113°46'30"E, dead coral substrate, embedded in calcareous substrate, 30 m, coll. P.A. Hutchings, 22 May 1994, holotype (AM W26500); paratypes: 5 (AM W26501), SE end of Long Is., Goss Passage, 28°28'48"S 113°46'30"E, dead coral substrate embedded in calcareous substrate, 30 m, coll. P.A. Hutchings, 22 May 1994; 7 (AM W26502), Goss Passage, Beacon Is., 28°25'30"S 113°47'E, dead coral plates covered in coralline algae, 8 m, coll. P.A. Hutchings, 22 May 1994; 2 (AM W26503), N end of Long Is., Goss Passage, 28°28'18"S 113°46'18"E, dead coral covered with coralline algae & boring bivalves, 8 m, coll. C. Bryce, 22 May 1994; 3 (AM W26504) and 6 (AM W26505), NE entrance to Goss Passage, Beacon Is., 28°27'54"S 113°46'42"E, dead *Acropora* sp., coralline & brown algae on coral substrate, 24 m, coll. P.A. Hutchings, 25 May 1994; 1 (on SEM stub), (AM W27096), N end of Long Is., 28°27'54"S 113°46'18"E, dead coral substrate with coralline & brown algae, 5 m, coll. C. Bryce, 22 May 1994; 2 (AM W27097) and 1 (on SEM stub) (AM W27144), off S end of Long Is., Beacon Is., 28°28'48"S 113°46'18"E, dead coral substrate covered in coralline algae, 5 m, coll. P.A. Hutchings, 25 May 1994. Houtman Abrohlos; Goss Passage, Beacon Is., 28°25'30"S 113°47'E, dead plates of *Acropora* sp., covered in coralline algae, 8 m, coll. P.A. Hutchings, 22 May 1994, 1 (AM W30148); NE entrance to Goss Passage, Beacon Is., 28°27'54"S 113°46'42"E, dead branching staghorn *Acropora* sp., coralline & brown algae, 24 m, coll. P.A. Hutchings, 25 May 1994, 2 (AM W30149); Goss Passage, Beacon Is., 28°25'30"S 113°47'E, dead plates of *Acropora* sp., covered in coralline algae, 20 m, coll. P.A. Hutchings, 20 May 1994, 1 (AM W30150); NE entrance to Goss Passage, Beacon Is., 28°27'54"S 113°46'42"E, dead plate-like *Acropora* sp., covered in coralline algae, 8 m, coll. P.A. Hutchings, 25 May 1994, 1 (AM W30151); Goss Passage, Beacon Is., 28°25'30"S 113°47'E, dead plates of *Acropora* sp., covered in coralline algae, 8 m, coll. P.A. Hutchings, 19 May 1994, 4 (AM W30152). **New South Wales:** Bass Point, 34°36'S 150°54'E, coll. The Ecology Lab for RMI/Pioneer Project, 1990, 50 m, 1 (AM W23861); E of Long Reef, 33°43'37"S 151°19'27"E, sand, 30 m, coll. NSW Fisheries Research Institute, 24 July 1989, 1 (AM W24376).

Description. Body long and slender. Holotype complete, 6 mm long, 0.2 mm wide, with 48 chaetigers; without colour markings. Largest paratype 7 mm long, 0.23 mm wide, with 55 chaetigers, mid-body and posterior segments clearly defined by inter-segmental constrictions. Prostomium oval to sub-pentagonal, wider than long with 4 small eyes in trapezoidal arrangement and 1 pair of anterior eyespots (Fig. 21A), not always visible (Fig. 21B). Antennae longer than combined length of prostomium and palps, with 12–13 articles, 3–4 basal articles indistinct; lateral antennae originating close to anterior pair of eyes, shorter than median antenna, similar in length to palps (Fig. 21A,B), with 5–9 articles. Palps long, about 1.5–2× length of prostomium, dorsally fused except for distal tip (Fig. 21A,B). Nuchal organs ventrolaterally located, as ciliated ridges surrounded by lips (see Fig. 3B, in San Martín & López, 2003). Tentacular segment well-developed, similar in length to

following ones; 1 pair of tentacular cirri, shorter than lateral antennae, with 3–4 articles. Dorsal cirri short and articulated, longer than parapodial lobes, with 2–5 articles, distal article typically longer and wider than others (Fig. 21A–D), slightly inflated. Parapodial lobes conical, distally rounded; ventral cirri digitiform, slightly longer than parapodial lobes (Fig. 21D). Anterior parapodia each with about 6 heterogomph compound chaetae; shaft heads smooth or with few slender spines. Chaetal blades distinctly bidentate, both teeth similar in size and shape, with coarse, moderately long spines along margin (Fig. 21E,I). Blade lengths decreasing progressively from 18 µm dorsally to 7.5 µm ventrally. Middle and posterior chaetigers also with about 6 heterogomph compound chaetae, blades with coarser serrations relative to chaetae of anterior parapodia, shafts with distinct spines. Blades of most dorsal compound chaetae distinctly longer than others, about 24 µm long, with distal tooth rounded and slightly expanded. Blades of other 5 compound chaetae show similar gradation to those of anterior parapodia. Dorsalmost chaetae with blades 15 µm long, with small subdistal tooth and larger, rounded distal one, ventralmost chaetae with blades 9 µm long, with both teeth robust and similar in size; distal one slightly more acute (Fig. 21I). Solitary dorsal simple chaetae from mid-body onwards, truncate, subdistal margin with several rows of coarse spines (Fig. 21F). Single ventral simple chaetae on posterior parapodia, slender, sigmoid, bidentate and smooth (Fig. 21G). Single acicula per parapodium, distally rounded, with hollow tip (Fig. 21H). Pharynx (Fig. 21A) through from segments 3–4 to 7–8, pharyngeal tooth large, near anterior rim, surrounded by crown of soft papillae. Proventricle shorter than pharynx, extending through 2 segments, with about 24 muscle cell rows. Pygidium triangular, distally rounded, with pair of anal cirri, similar in length and shape to dorsal cirri, with 2–3 articles (Fig. 21C).

Habitat. Occurs from 5–30 m in amongst dead coral rubble covered with coralline algae.

Distribution. Australia (Central Western Australia, New South Wales).

Genus *Parasphaerosyllis* Monroe, 1937

Parasphaerosyllis Monroe, 1937: 273.

Diagnosis. Body of medium to large size, with numerous segments. Prostomium with 3 antennae, 2 pairs of eyes, sometimes 1 pair of anterior eyespots, and 2 palps. Palps fused basally. Two pairs of tentacular cirri. Antennae, tentacular, anal, and anterior dorsal cirri distinctly articulate, from mid-body alternating long strongly articulated dorsal cirri with short, unarticulated, lemon-like shaped cirri. Pharynx similar in length or longer than proventricle, with tooth, located on anterior rim, surrounded by crown of soft papillae. Compound chaetae with falcigerous blades; dorsal and ventral simple capillary chaetae present. Ventral cirri ovate. Schizogamic reproduction by means of stolons.

Type species: *Parasphaerosyllis indica* Monroe, 1937, by monotypy.

Remarks. *Parasphaerosyllis* is similar to *Syllis*, differing only in having some dorsal cirri with a single, expanded,

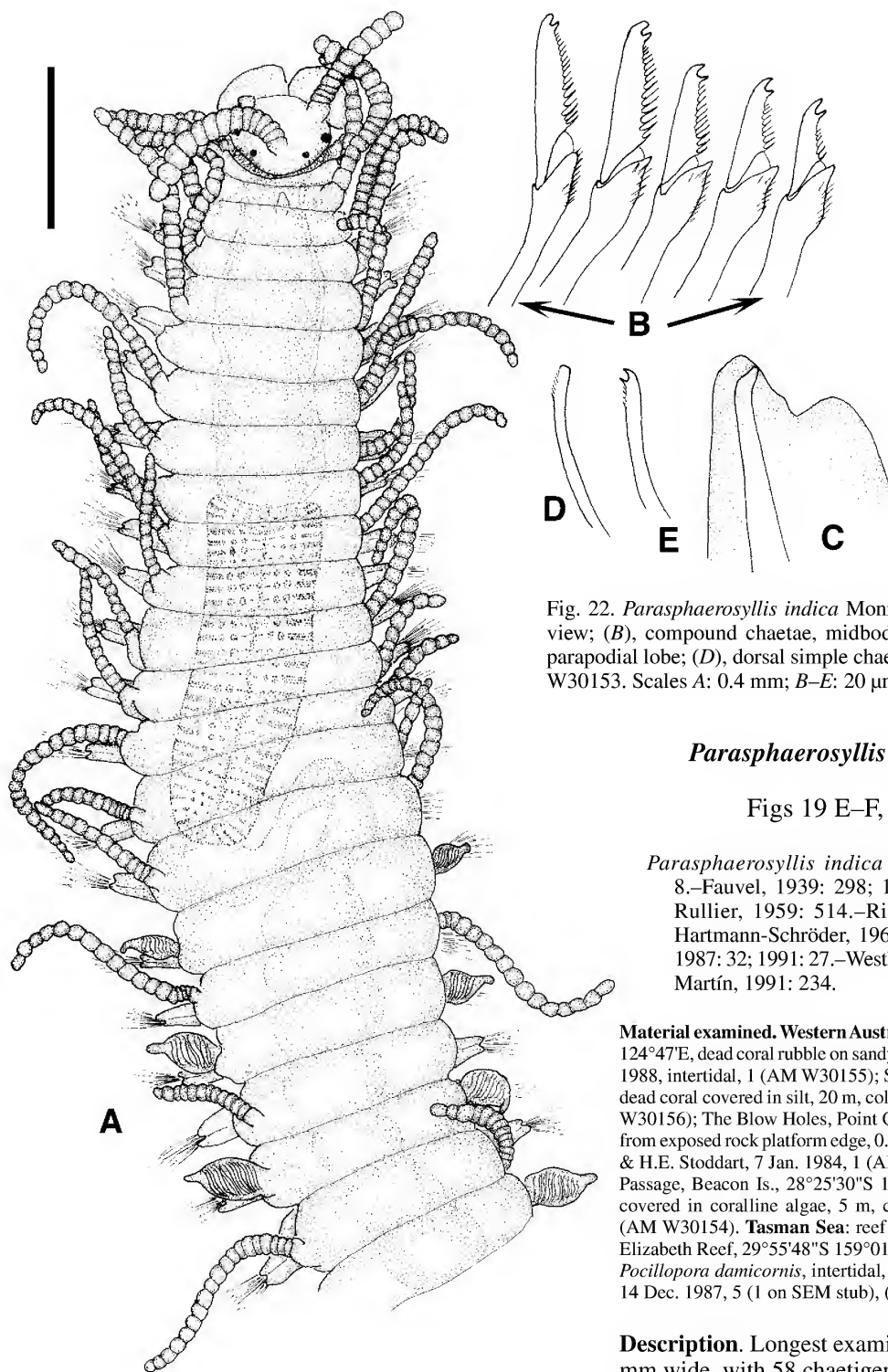


Fig. 22. *Parasphaerosyllis indica* Monro, 1937: (A), anterior end, dorsal view; (B), compound chaetae, midbody; (C), acicula and distal end of parapodial lobe; (D), dorsal simple chaeta; (E), ventral simple chaeta. AM W30153. Scales A: 0.4 mm; B–E: 20 μ m.

***Parasphaerosyllis indica* Monro, 1937**

Figs 19 E–F, 22A–E, 24A–B

Parasphaerosyllis indica Monro, 1937: 273, text-fig. 8.–Fauvel, 1939: 298; 1950: 351; 1953: 9.–Fauvel & Rullier, 1959: 514.–Rioja, 1958: 246, figs 21–27.–Hartmann-Schröder, 1960: 84, pl. 6, fig. 50; 1980: 49; 1987: 32; 1991: 27.–Westheide, 1974: 64, figs 27–29.–San Martín, 1991: 234.

Material examined. **Western Australia:** Kimberley region: Bernouli, 15°S 124°47'E, dead coral rubble on sandy substrate, coll. P.A. Hutchings, 12 July 1988, intertidal, 1 (AM W30155); S side of Long Reef, 14°01'S 125°44'E, dead coral covered in silt, 20 m, coll. P.A. Hutchings, 18 July 1988, 3 (AM W30156); The Blow Holes, Point Quobba, 24°39'S 113°25'E, green algae from exposed rock platform edge, 0.5 m, coll. J.K. Lowry, R.T. Springthorpe & H.E. Stoddart, 7 Jan. 1984, 1 (AM W26789); Houtman Abroghos, Goss Passage, Beacon Is., 28°25'30"S 113°47'E, dead plates of *Acropora* sp., covered in coralline algae, 5 m, coll. P.A. Hutchings, 22 May 1994, 2 (AM W30154). **Tasman Sea:** reef flat near "Yoshin Maru Iwaki" wreck, Elizabeth Reef, 29°55'48"S 159°01'18"E, small heads of *Acropora valida*, *Pocillopora damicornis*, intertidal, coll. J.K. Lowry & R.T. Springthorpe, 14 Dec. 1987, 5 (1 on SEM stub), (AM W30153).

Description. Longest examined specimen 4 mm long, 0.21 mm wide, with 58 chaetigers; largest known specimens up to 17 mm long, 0.27 mm wide, with 86 chaetigers. Body long and slender, colourless. Prostomium circular to ovate; 4 small eyes in open trapezoidal arrangement; median antenna inserted between posterior eyes, with up to 54 articles; lateral antennae inserted close to anterior margin of prostomium, in front of anterior eyes, with up to 24 articles. Palps fused at base, shorter than prostomium, sometimes ventrally folded. Nuchal organs not observed. Peristomium shorter than subsequent segments (Fig. 22A); dorsal tentacular cirri long, with up to 43 articles; ventral tentacular cirri shorter, with up to 22 articles. Dorsal cirri of anterior segments all

lemon-like shaped article. Five species are known: *P. indica*, the type species of the genus, has been reported widely from tropical waters; *P. uschakovii* (Chlebovitsch, 1959), from Kurile Islands, Russia; *P. ezoensis* Imajima & Hartman, 1964 and *P. setoensis* Imajima, 1966, both from Japan; and finally *P. malimalii* Capa *et al.*, 2001, from the Pacific coast of Panamá (see Capa *et al.*, 2001b, for a general discussion of the species of the genus).

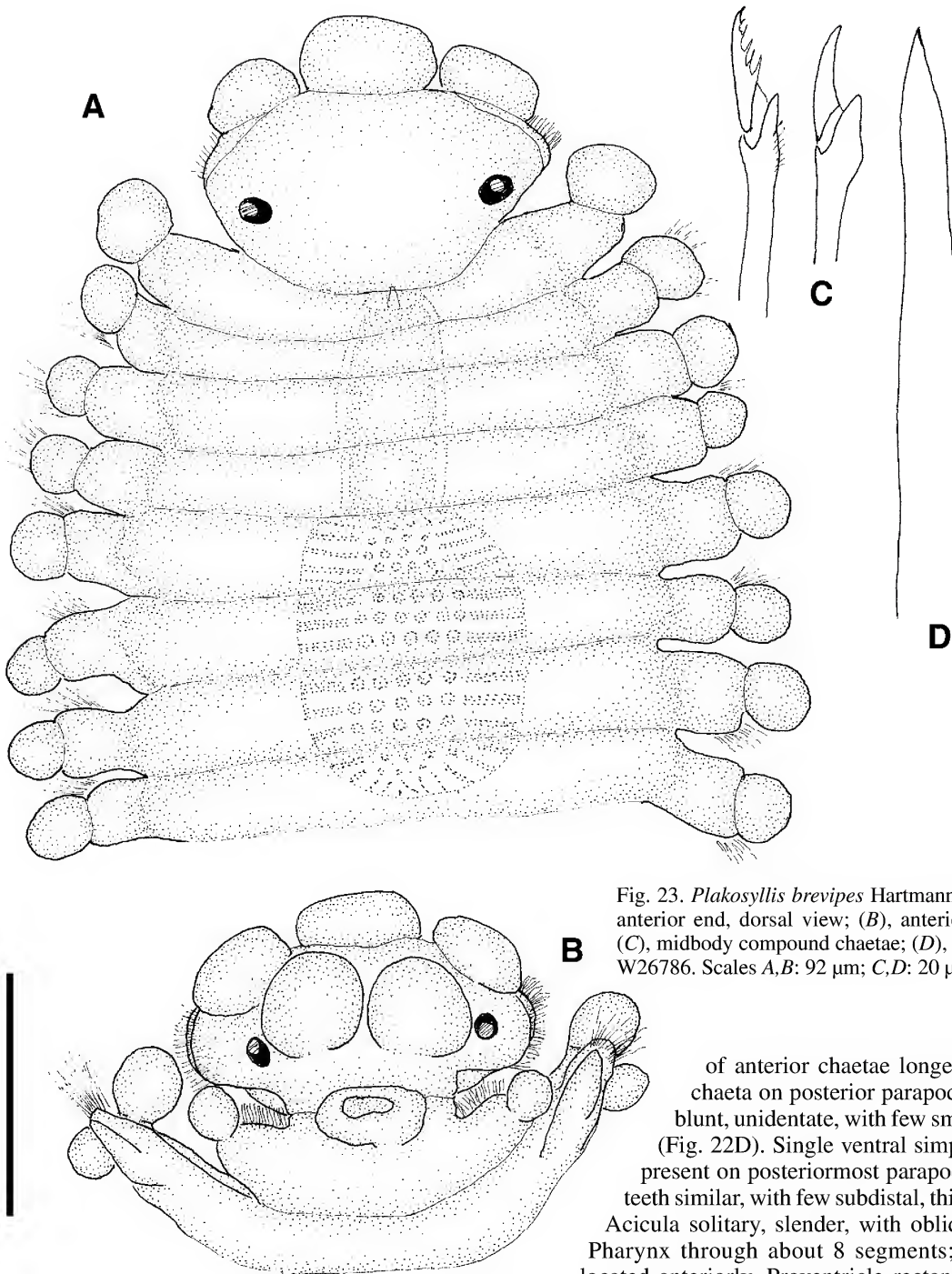


Fig. 23. *Plakosyllis brevipes* Hartmann-Schröder, 1956: (A), anterior end, dorsal view; (B), anterior end, ventral view; (C), midbody compound chaetae; (D), midbody acicula. AM W26786. Scales A,B: 92 μ m; C,D: 20 μ m.

articulated, long, alternating irregularly in length; from level of proventricle to posterior part of body, dorsal cirri alternating long and articulated, with 25–40 articles, and short cirri, lemon-like shaped, unarticulated cirri, provided with distinct cirrophore, and dark, fibrillar inclusions (Fig. 22A). Lemon-like shaped cirri with some dorsal pores (Fig. 19E,F, arrows). Parapodia dorsally slightly bilobed (Fig. 22A,C). Ventral cirri digitiform, shorter than parapodial lobes. Compound chaetae, heterogomph falcigers; shafts distally with thin spines; blades bidentate, both teeth similar, with spines on margin (Figs 22B, 24A,B); anterior parapodia with 7 compound chaetae, number decreasing posteriorly, 5 from midbody onwards; dorsoventral gradation in length of blades, 20 μ m long above, about 16 μ m long below; blades

of anterior chaetae longer. Capillary simple chaeta on posterior parapodia, distally curved, blunt, unidentate, with few small subdistal spines (Fig. 22D). Single ventral simple capillary chaeta present on posteriormost parapodia, bidentate, both teeth similar, with few subdistal, thin spines (Fig. 22E). Acicula solitary, slender, with oblique tip (Fig. 22C). Pharynx through about 8 segments; pharyngeal tooth located anteriorly. Proventricle rectangular, through 7–8 segments, with 26–30 muscle cell rows.

Remarks. The senior author has examined material from the Canary Islands, Cape Verde Islands, Cuba, Panamá (Pacific), México (Pacific), and all are similar, however with such a wide distribution, molecular studies would be useful to confirm the identity of each of these disjunct populations.

Habitat. Occurs from intertidal to shallow depths on algae, dead coral substrate and coralline algae.

Distribution. Circumtropical to temperate waters, Australia (North and Central Western Australia, Victoria, New South Wales, Queensland).

Genus *Plakosyllis* Hartmann-Schröder, 1956*Plakosyllis* Hartmann-Schröder, 1956: 87.

Diagnosis. Body small, oval, elongated, dorsoventrally flattened. Prostomium with 2 pairs of eyes, 3 antennae and 2 spherical palps. Antennae inserted on anterior margin of prostomium; palps inserted ventrally, not fused. Dorsum without tubercles. Two pairs of tentacular cirri. Antennae, tentacular and dorsal cirri not articulated, spherical. Ventral cirri triangular, with numerous minute pores. Two anal cirri similar to dorsal cirri. Compound chaetae are short falcigers. Pharynx similar in length or longer than proventricle, with anterior dorsal tooth, surrounded by crown of about 10 soft papillae. Proventricle short. Schizogamic reproduction by means of *Tetraglene* stolons provided with 2 pairs of eyes inserted ventrolaterally. (For illustration of *Tetraglene* stolons of *Plakosyllis brevipes* which lack antennae, see San Martín [2003, fig. 4D]).

Type species: *Plakosyllis brevipes* Hartmann-Schröder, 1956, by monotypy.

Remarks. This genus is closely related to *Eurysyllis*, differing in the absence of dorsal tubercles and fused palps. Two species of this genus are known, *P. brevipes* and *P. quadrioculata* Perkins, 1981; the former has been reported as being circumtropical as well as occurring in subtropical waters of south Western Australia (Hartmann-Schröder, 1982) and this study expands its known distribution within Australia. The other species has been reported only from the Gulf of México and the Caribbean.

***Plakosyllis brevipes* Hartmann-Schröder, 1956**

Figs 23A–D, 24C,D

Plakosyllis brevipes Hartmann-Schröder, 1956: 87, figs 1–8; 1982: 67, figs 48–50; 1982: 21.–Laubier, 1967: 98.–Campoy, 1982: 302.–San Martín, 2003: 300, figs 165, 166.

Eurysyllis brevipes Gidholm, 1962: 250, fig. 1.

Material examined. Western Australia: inshore limestone reef, Neds Camp, Cape Range National Park, 21°59'S 113°55'E, small purple sponge with *Caulerpa* sp. & sticky sediment, 1.5 m, coll. R.T. Springthorpe, 2 Jan. 1984, 1 (on SEM stub) (AM W26786); Houtman Abrohos: Goss Passage, Beacon Is., 28°25'30"S 113°47'E, dead plates of *Acropora* sp., covered in coralline algae & sponges, 23 m, coll. P.A. Hutchings, 19 May 1994, 1 (AM W30157). **New South Wales:** 100 m NW of Julian Rocks, Byron Bay, 28°36'48"S 153°37'48"E, shell & gravel, 15 m, coll. G.D.F. Wilson, R.T. Springthorpe & L. Albertson, 3 Mar. 1992, 2 (on SEM stub), (AM W26329); 100 m NW of Julian Rocks, Byron Bay, 28°36'48"S 153°37'48"E, sponge surface, 15 m, coll. S.J. Keable & R.T. Springthorpe, 4 Mar. 1992, 1 (AM W26330); Ledge on N side, Cook Is., 28°11'26"S 153°34'40"E, shell grit, 14 m, coll. K. Attwood, 8 June 1993, 1 (AM W26331).

Additional material. *Plakosyllis brevipes*. SPAIN: Balearic Is; Cabo Nati, NW of Menorca, 40°43'10" N, 03°49'28"E, 31 m, 4 (MNCN 16.01/6605).

Description. Body strongly flattened, oval-elongated (Fig. 24C), without colour markings, small, up to 4 mm long, 0.21 mm wide, with 40 chaetigers. Prostomium proportionally large, wide, pentagonal to trapezoidal (Figs 23A, 24C,D),

laterally ciliated; with 1 pair of dorsal and 1 pair of ventral eyes. Antennae spherical, inserted on anterior margin of prostomium. Palps ventrally located, not visible dorsally, spherical, separated from each other (Fig. 23B). Nuchal organs not observed. Peristomium shorter than following segments, anterior margin ciliated; dorsal tentacular cirri similar in size to dorsal cirri, ventral tentacular cirri smaller than dorsal ones, only visible ventrally. Dorsal cirri with distinct cirrophore and spherical, unarticulated cirrostyle (Figs 23A,B, 24C,D); ventral cirri conical, longer than parapodial lobes. Parapodial lobes acute. About 10–12 compound chaetae on midbody parapodia, with short shafts, some distally with short spines, and short, unidentate blades; most blades smooth, but 1–3 dorsal ones with long spines (Fig. 23C). Acicula solitary, stout, almost straight (Fig. 23D), protruding from parapodial lobes. Dorsal and ventral simple chaetae not seen. Pharynx short, slender, through 4–5 segments; pharyngeal tooth located on anterior margin (Fig. 23A). Trepan not seen on examined specimens, but described by Perkins (1981) as having 10 small teeth surrounding anterior border of pharynx. Proventricle short, barrel-shaped, with 11–14 muscle cell rows. Pygidium incised, with 2 anal cirri similar to dorsal cirri but smaller and oval. Some specimens with attached developing stolons (Fig. 24C).

Habitat. Occurs intertidally to 60 m depth, interstitially in coarse sand, on algae, sponges, and rhizomes of seagrasses.

Distribution. Mediterranean Sea, NE and NW Atlantic Ocean, Red Sea, Indian Ocean, New Caledonia, Australia (Western Australia, New South Wales).

Genus *Rhopalosyllis* Augener, 1913*Rhopalosyllis* Augener, 1913: 245.

Diagnosis. Body long, robust, cylindrical, with numerous segments; most posterior segments achaetous. Body covered with numerous, small papillae, present on prostomium, parapodia and anal cirri, both dorsally and ventrally. Prostomium with 4 eyes and 3 antennae. Palps fused at bases, rounded, sometimes ventrally folded. Peristomium dorsally reduced, with 2 pairs of tentacular cirri. Nuchal organs as paired ciliated grooves between prostomium and peristomium. Dorsal and ventral cirri present on all parapodia. Antennae, tentacular and dorsal cirri obscurely articulated, short, oval to spindle-shaped, rough, covered by papillae. Ventral cirri conical. Compound chaetae heterogomph; on posterior segments some chaetae with fused shafts and blades, forming thick, bidentate hooks; dorsal and ventral simple chaetae present on most posterior parapodia. Pharynx and proventricle short; pharyngeal tooth long and slender. Reproduction by stolons.

Remarks. The genus consists of a single species, known only from Western Australia.

Type species: *Rhopalosyllis hamulifera* Augener, 1913, by monotypy.

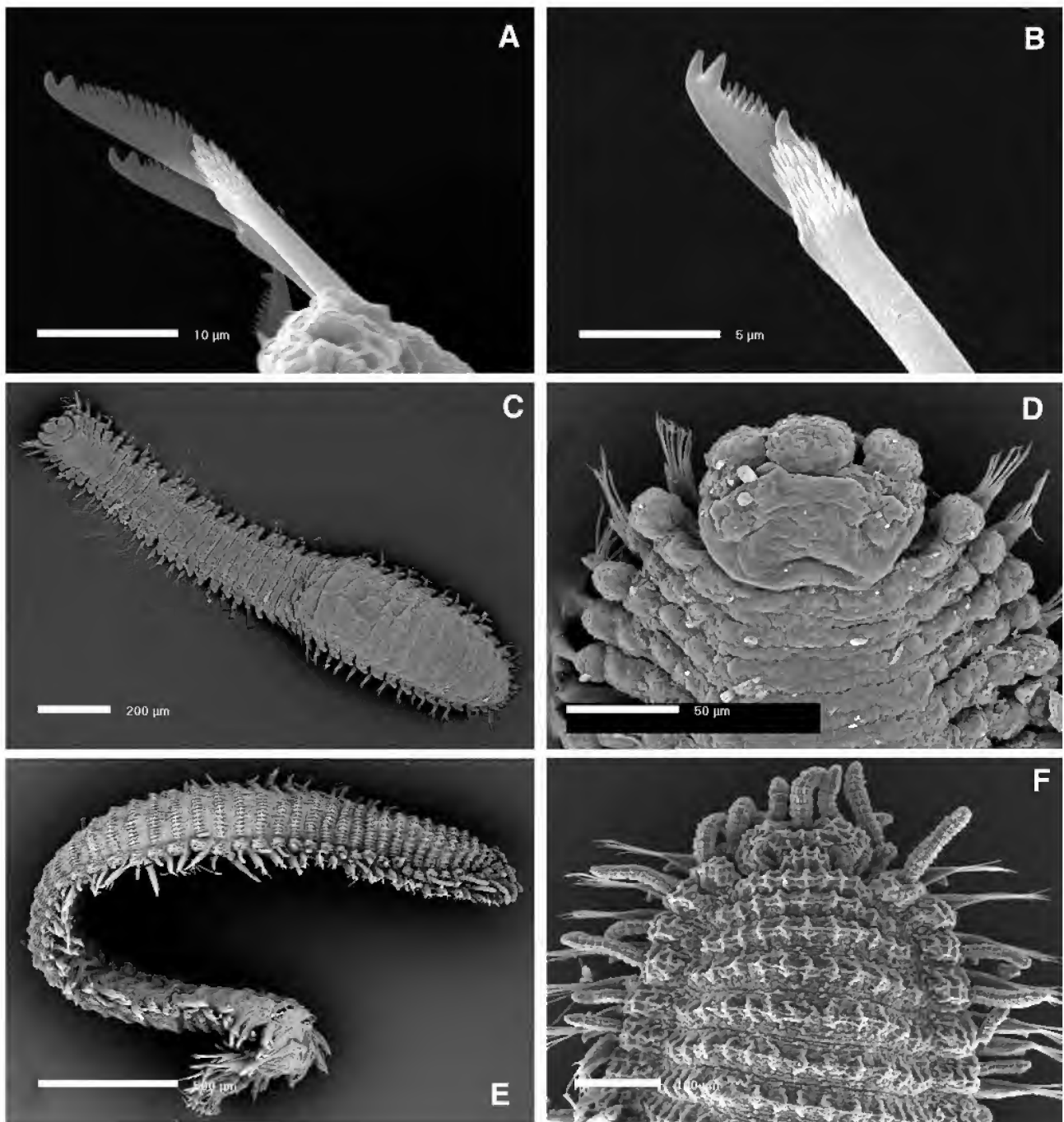


Fig. 24. SEM of *Parasphaerosyllis indica* Monro, 1937: (A), superior compound chaetae; (B), inferior compound chaeta. SEM of *Plakosyllis brevipes* Hartmann-Schröder, 1956: (C), complete specimen with stolon, dorsal view; (D), anterior end, dorsal view. SEM of *Xenosyllis moloch* n.sp.: (E), complete specimen, dorsolateral view; (F), anterior end, dorsal view. A,B: AM W30153; C,D: AM W26786; E,F: AM W30160.

Rhopalosyllis hamulifera Augener, 1913

Figs 25A–F, 26A–M

Rhopalosyllis hamulifera Augener, 1913: 245–247, Pl. III,
Figs 24, 25, Text-Fig. 36 a–c.

Material examined. **Western Australia.** Sharks Bay, syntypes 1 (fragment) (HZM V-10076) 11–16 m, 1 (HZM V-7963). Kimberley region, reef south of Lucas Is., Brunswick Bay, 15°16'S 124°29'E, dead coral & *Sargassum* with heavy silt load, intertidal, 2 m, coll. P.A. Hutchings, 24 July 1988, 1 (juvenile) (AM W30158); Inshore limestone reef, Neds Camp, Cape Range National Park, 21°59'S 113°55'E, *Caulerpa* sp., 1 m, coll. J.K. Lowry, 2 Jan. 1984, 1 (AM W26740).

Description. Body long, cylindrical, broad anteriorly, tapered posteriorly (Fig. 25B), 8.2 mm long, 0.36 mm wide, 0.40 mm maximum width at mid-body, with 82 chaetigers, plus 6–7 achaetous segments. Numerous small papillae covering dorsal and ventral surfaces, antennae, tentacular, dorsal, ventral, and anal cirri, as well as parapodial lobes (Fig. 25A–F). Prostomium oval, with 4 small eyes in open trapezoidal arrangement. Antennae thick, rough, short, shorter than combined length of prostomium and palps, oval; lateral antennae inserted on anterior margin, median antenna inserted just behind anterior margin of prostomium (Fig. 25A). Palps large, broad, ventrally folded (Fig. 25A,C,E).

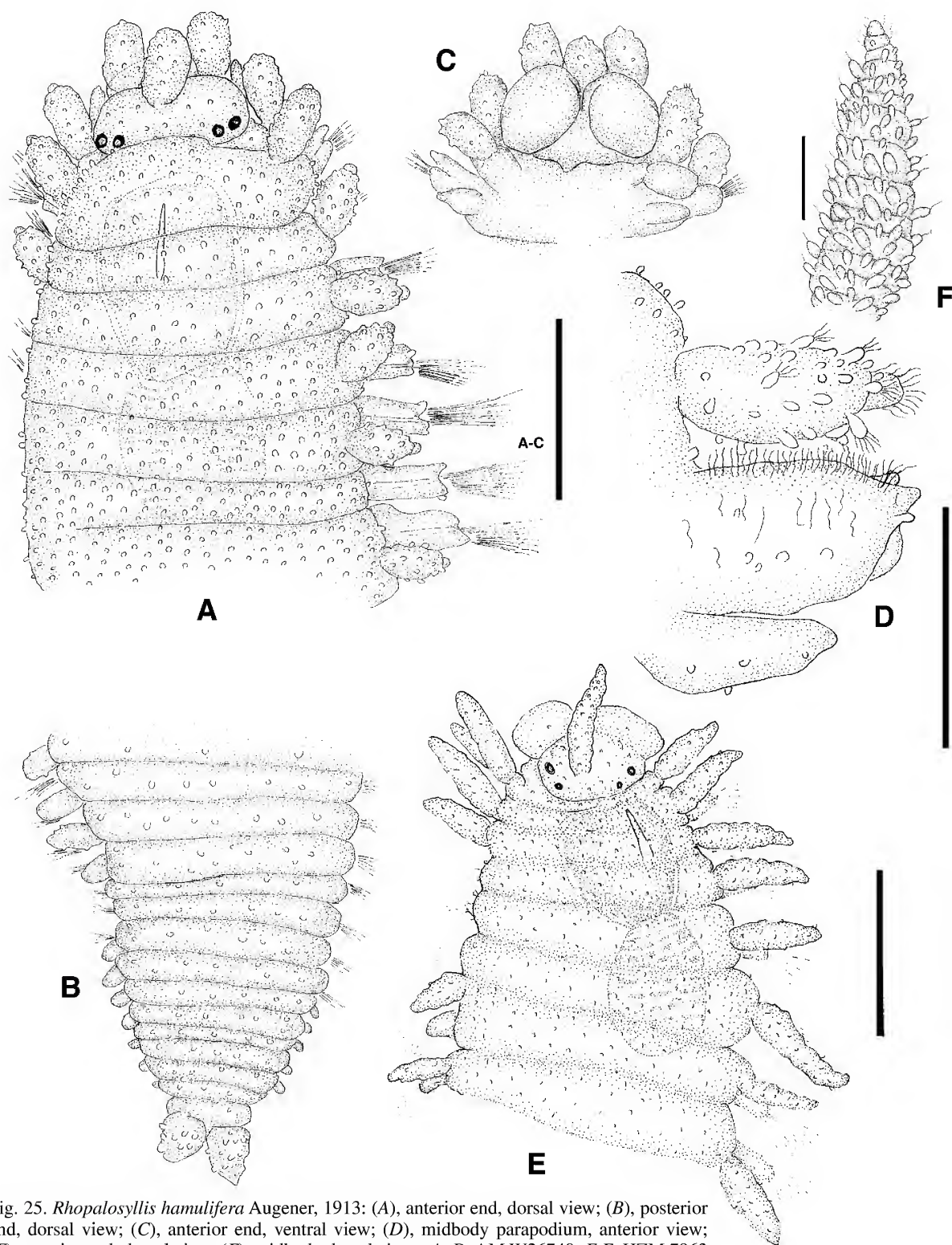


Fig. 25. *Rhopalosyllis hamulifera* Augener, 1913: (A), anterior end, dorsal view; (B), posterior end, dorsal view; (C), anterior end, ventral view; (D), midbody parapodium, anterior view; (E), anterior end, dorsal view; (F), midbody dorsal cirrus. A–D: AM W26740; E, F: HZM 7963 (syntype). Scales A–C: 0.18 mm; D, F: 92 μ m; D: 0.20 mm.

Nuchal organs not observed. Peristomium dorsally reduced, covered by fold of chaetiger 1; tentacular cirri similar to antennae, ventral ones smaller than dorsal tentacular cirri. Dorsal cirri similar in shape to antennae and tentacular cirri, each with terminal button, covered with tufts of long cilia (Fig. 25D); some papillae of dorsal cirri also provided with

tufts of cilia. Parapodia with 1 pre-chaetal and 2 post-chaetal terminal papillae; ventral cirri conical, shorter than parapodial lobes (Fig. 25D). Parapodia of first 3 chaetigers with about 10 compound, heterogomph chaetae, with short shafts and small, bidentate, short blades (Fig. 26A), both teeth similar in size, 6–7 μ m long. Subsequent anterior parapodia with

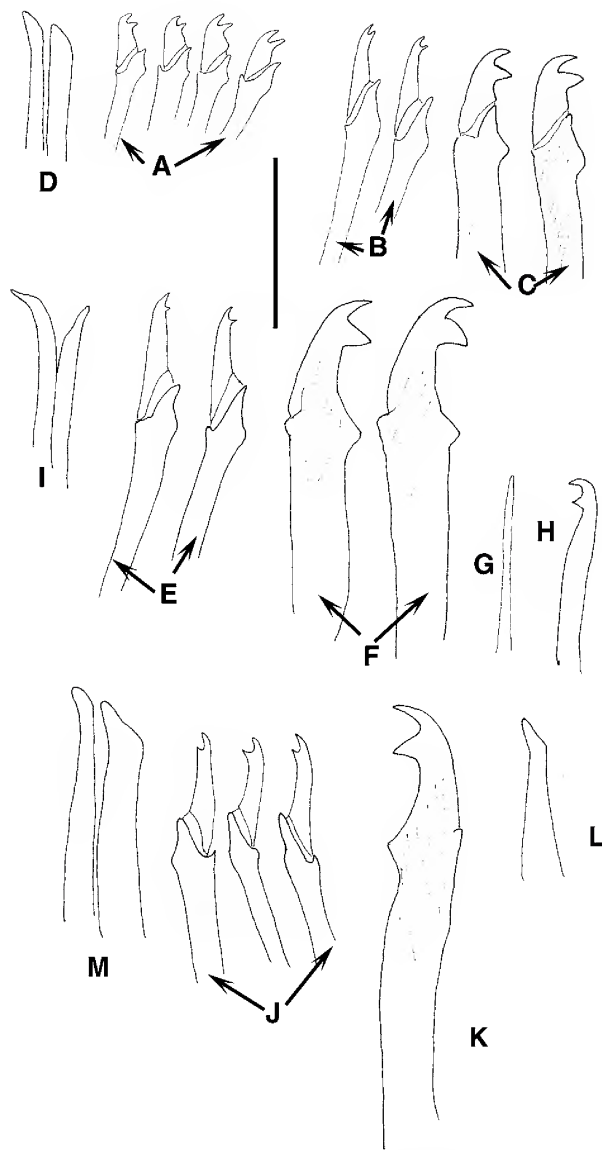


Fig. 26. *Rhopalosyllis hamulifera* Augener, 1913: (A), most anterior compound chaetae; (B), superior chaetae, anterior parapodium; (C), inferior compound chaetae, anterior parapodium; (D), anterior aciculae; (E), midbody superior compound chaetae; (F), midbody inferior chaetae; (G), dorsal simple chaeta; (H), ventral simple chaeta; (I), midbody aciculae; (J), posterior superior compound chaetae; (K), inferior posterior chaeta; (L), posterior acicula. A–L: AM W26740. Scale: 20 μ m.

about 5 compound, heterogomph chaetae with long, slender shafts, and thin, bidentate, smooth blades (Fig. 26B), about 12 μ m long, plus 2 compound chaetae with enlarged shafts, bidentate blades, about 12 μ m long, partially fused to shafts, most ventrally located (Fig. 26C); ventral chaetae becoming totally fused on posterior parapodia, forming large bidentate hooks (Fig. 26F), and remaining chaetae similar to those present on anterior chaetigers (Fig. 26E). About 5 compound chaetae on posterior parapodia, similar to those present on anterior and mid-body parapodia (Fig. 26J), and single, thick hook (Fig. 26K). Dorsal and ventral simple chaetae present on most posterior parapodia. Dorsal simple chaetae slender, needle-shaped (Fig. 26G); ventral simple chaetae thick, strongly bidentate, thinner than compound chaetae

(Fig. 26H). Anterior and midbody parapodia with 2 slender aciculae, 1 straight, other slightly bent (Fig. 26D,I,M); single acicula in posterior parapodia. Pharynx wide, extending through 3 segments; pharyngeal tooth long and slender, $\frac{1}{3}$ length of pharynx (Fig. 25A,E), may be difficult to see. Proventricle short, small, through 3 segments, with about 15 muscle cell rows. Pygidium rectangular, with 2 oval to conical anal cirri (Fig. 25B). One specimen examined is a female with oocytes in posterior segments.

Remarks. The examined specimens agree well with the original description but the antennae and dorsal cirri are proportionally shorter and wider. The type material has apparently smooth antennae and dorsal cirri, but under higher magnification they can be seen to be articulated with 12–14 articles, densely covered by papillae, some of them with one distal cilium. One syntype (HBM V-7963) is developing a sexual stolon.

Habitat. Occurs intertidally and in shallow depths, in amongst dead coral rubble and algae.

Distribution. Australia (North Western Australia).

Genus *Tetrapalpia* n.gen.

Opisthosyllis dorsoaciculata Hartmann-Schröder, 1991: 26, figs 20–25.

Diagnosis. Body of medium size, dorsally cylindrical, with numerous segments. Prostomium with 4 eyes and, sometimes, a pair of eyespots, 3 antennae and 2 palps. Palps free, with distinct gap between them; each palp bilobed with lobes fused for most of their length. Two pairs of tentacular cirri. Antennae, tentacular, anal, and dorsal cirri distinctly articulated. Parapodia bi-lobed. Ventral cirri triangular. Compound chaetae with short falcigerous blades; capillary chaetae present. Pharynx shorter than proventricle; tooth inserted just behind from anterior margin of pharynx. Reproduction by means of stolons.

Type species. *Opisthosyllis dorsoaciculata* Hartmann-Schröder, 1991 by subsequent designation.

Remarks. The single known species of the genus, only known from the type-locality in Queensland, was originally described as belonging to the genus *Opisthosyllis* Langerhans, 1879; however, this species differs in several characters from other species in this genus. The pharyngeal tooth is located just behind the opening of the pharynx, which is shorter than the proventricle; in *Opisthosyllis* the pharynx is longer than the proventricle and the tooth is located posteriorly. *Tetrapalpia* is unusual in having palps free to their bases; each palp is bilobed, with the lobes fused for most of their length; so that it appears as if four palps are present. This palpal configuration is unique within the family Syllidae.

Etymology. The generic name derives from the Latin *Tetra*, meaning four, in reference to the appearance of having four palps present rather than the two typical for the family.

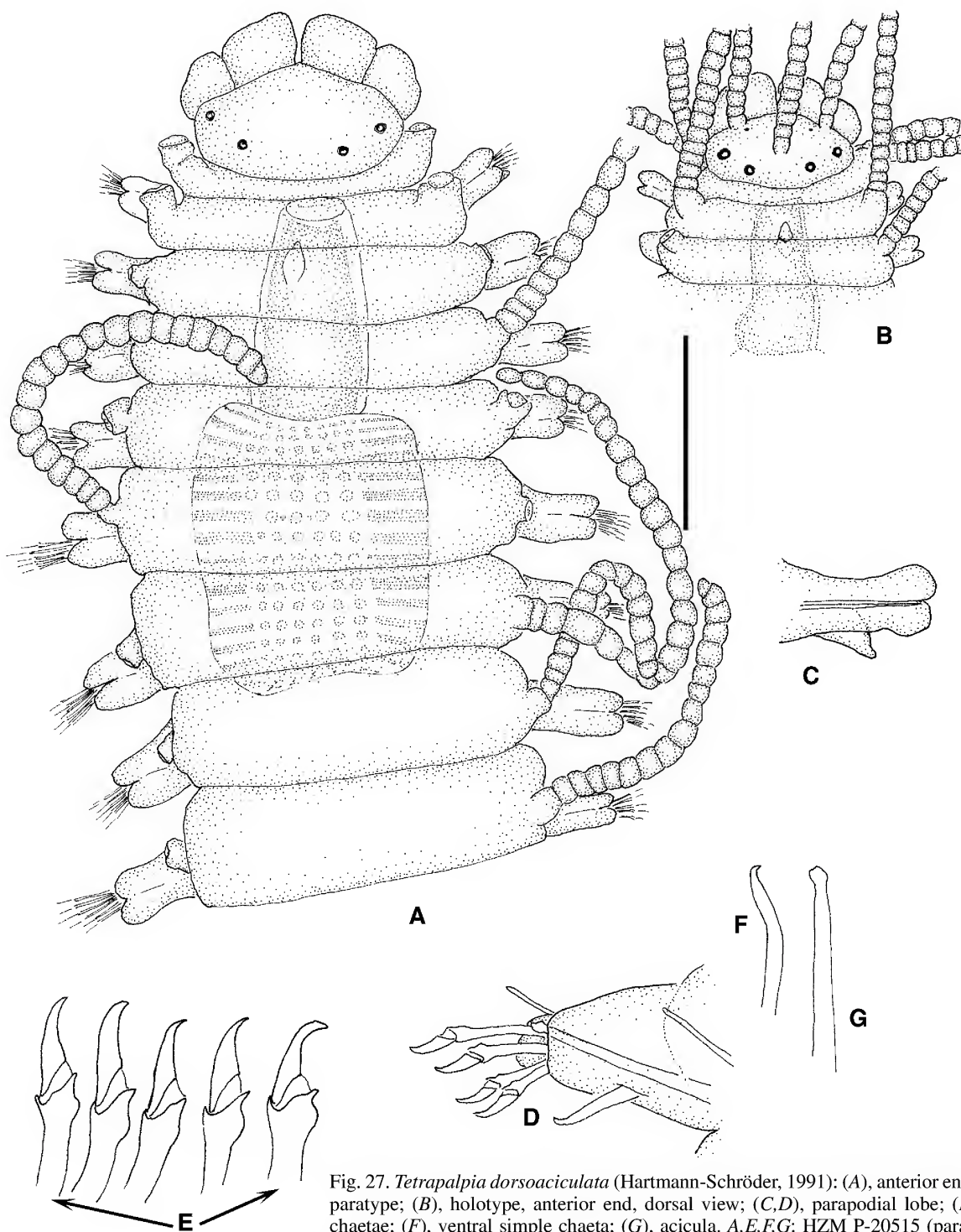


Fig. 27. *Tetrapalpia dorsoaciculata* (Hartmann-Schröder, 1991): (A), anterior end, dorsal view, paratype; (B), holotype, anterior end, dorsal view; (C,D), parapodial lobe; (E), compound chaetae; (F), ventral simple chaeta; (G), acicula. A,E,F,G: HZM P-20515 (paratype). B,C,D: after Hartmann-Schröder, 1991, holotype. Scales A: 0.14 mm; E–G: 20 μ m.

***Tetrapalpia dorsoaciculata*
(Hartmann-Schröder, 1991) n.comb.**

Fig. 27A–G

Opisthosyllis dorsoaciculata Hartmann-Schröder, 1991: 26, figs 20–25.

Material examined. Queensland. Heron Is., North Reef, 23°27'S 151°55'E, coral sand from tidal pool among corals, intertidal, coll. G. Hartmann-Schröder, 6 Feb. 1976, HOLOTYPE, (ZMH P-20514), PARATYPES, 3 (HZM P-20515), 1 (AM W20389) 2 (HZM P-20532).

Description. Based on Hartmann-Schröder (1991), and our own re examination of the types. Body of medium size, long and slender, holotype 5.6 mm long (*vide* Hartmann-Schröder, 1991), 0.3 mm wide, with 62 chaetigers, with developing sexual stolon of 10 chaetigers, dorsally cylindrical. Prostomium oval to pentagonal, wider than long, with 4 eyes and, sometimes pair of eyespots. Median antenna inserted on middle of prostomium (Fig. 27B), with 25 articles; lateral antennae with 13 articles. Palps free from each other, with longitudinal groove, appearing bilobed (Fig. 27A). Nuchal organs not observed. Two pairs of tentacular

cirri; dorsal tentacular cirri with 33 articles, ventral ones with 12. Antennae, tentacular, anal, and dorsal cirri articulated, fragile, slender (Fig. 27A). Parapodia bi-lobed (Fig. 27C,D). Ventral cirri triangular (Fig. 27C). Compound chaetae with short falcigerous, unidentate blades (Fig. 27E,D); anterior parapodia with 10 chaetae, decreasing to 8 on midbody and 4–6 on posterior parapodia; dorsal capillary chaetae on posterior parapodia, slender, unidentate (Fig. 27D); ventral simple chaetae sigmoid, unidentate, smooth (Fig. 27D,F), present on posterior parapodia. Aciculae solitary, slender, distally knobbed (Fig. 27G). Pharynx shorter than proventricle, though 3–4 segments (Fig. 27A,B); tooth located just behind anterior opening of pharynx. Proventricle through 3 segments, with 17–19 muscle cell rows.

Remarks. This species and this new genus is characterized by each palp being incompletely divided by a furrow or groove. This character is only visible when antennae are detached as on some of the paratypes and were overlooked in the original description which explains why they were placed in the wrong genus originally.

Habitat. Occurs in shallow water, interstitially in coralline sand.

Distribution. Australia (Heron Island, Queensland).

Genus *Xenosyllis* Marion & Bobretzky, 1875

Xenosyllis Marion & Bobretzky, 1875: 26.

Diagnosis. Body of medium size, elongated, dorsoventrally flattened, convex dorsally, with numerous, short segments. Prostomium with 4 eyes, 3 antennae and 2 palps. Palps free from each other, ventrally located. Prostomium and lateral margins of each segment with papillae; dorsally provided with longitudinal striations. Tentacular segment reduced, dorsally with distinct medial, marginally papillated lobe. Antennae, tentacular, anal, and dorsal cirri short, articulated, covered by papillae. Pharynx long, unarmed. Proventricle short. Compound chaetae with falcigerous blades; capillary simple chaetae also present. Two anal cirri.

Type species: *Syllis scabra* Ehlers, 1864 by monotypy.

Remarks. Prior to this study the genus was known only from the type species from the Mediterranean Sea and North Atlantic. Two new species have been found, *Xenosyllis moloch* and *Xenosyllis scabroides*. The genus has not previously been recorded from Australia.

Xenosyllis moloch n.sp.

Figs 24E,F, 28A–D, 29A–F, 30A–D

Type material. HOLOTYPE, (AM W30159), **Tasman Sea:** Taupo Seamount, 33°16'51"S 156°09'09"E, 244 m, coll. J.K. Lowry on RV "Franklin", 2 May 1989, PARATYPES 15 (4 on SEM stub), (AM W30160).

Additional material examined. *Xenosyllis scabra*. SPAIN: Mediterranean Sea. S La Horadada, Islas Columbretes, Castellón, 39°52'38"–39°52'36"N 00°40'07"–00°40'28"E, 24 m, 1 (MNCN 16.01/6616).

Description. Longest examined specimen 5 mm long, 0.6 mm wide, with 64 chaetigers. Body markedly flattened, ribbon-like, somewhat convex dorsally with numerous short segments (Figs 24E, 28A), anteriorly blunt, posteriorly tapered (Fig. 24E). Prostomium, cirrophores and cirri covered with numerous papillae (Figs 24E–F, 28A, 29A–E); dorsum with numerous papillae and crests arranged longitudinally, each crest terminating in an anteriorly directed spine (Figs 24F, 28A, 29A,C); each with 1–2, or 3, distal pores (Fig. 29D,E, arrows), only visible under SEM. Degree of papillation and ornamentation of dorsum, variable between individuals. Prostomium bilobed, provided with numerous papillae (Figs 24F, 29A); 4 large subdermal eyes (Fig. 28A). Antennae originating on anterior margin, lateral ones more ventrally located; median antenna with about 8 articles; lateral antennae with 4–6 articles. Palps not visible dorsally (Figs 24F, 28A, 29A), ventrally inserted, totally separated from each other (Figs 28B, 29B). Nuchal organs not observed. Peristomium dorsally visible only as semicircular flap with highly sculptured surface, covering posterior part of prostomium (Figs 28A, 29A,C); tentacular cirri longer than antennae; dorsal tentacular cirri with about 12 articles; ventral tentacular cirri inserted latero-ventrally, with about 9 articles. Dorsal cirri and antennae with apparently smooth articles (light microscope) (Fig. 28A), but under SEM with small longitudinal crests (Figs 24F, 29A–C,F). Dorsal cirri short, inserted on distinct, strongly papillated cirrophores; dorsal cirri of 2–3 anteriormost segments longer than subsequent ones, with 12–9 articles; remaining dorsal cirri longer than parapodial lobes, with 5–6 articles; usually with distal article of cirri and antennae longer than others (Fig. 29F). Parapodia elongated with pointed tips (Fig. 29F), posteriorly slender (Fig. 30A). Ventral cirri triangular, elongated, inserted distally on parapodia. Compound chaetae numerous, heterogomph, bidentate falcigers, with proximal tooth smaller than distal one, and short, fine marginal spines (Figs 28C, 30B–D), ventralmost chaetae with shorter spines, straight, 12–14 chaetae on midbody; dorsoventral gradation in length, from about 25 µm dorsally, 17 µm ventrally. Aciculae

Key to Australian species of *Xenosyllis*

- 1 Body flattened, with numerous longitudinal crests (more than 30 on midbody segments). Antennae and dorsal cirri apparently without longitudinal crests (but visible under the SEM). Palps not visible dorsally. Chaetae within a fascicle with distinct dorsoventral gradation in length of blades *X. moloch* n.sp.
- Body flattened, with fewer longitudinal crests on dorsum (less than 30 on midbody segments). Antennae and dorsal cirri with distinct longitudinal crests. Palps dorsally visible. Chaetae within a fascicle with blades of similar length *X. scabroides* n.sp.

solitary, thick, protruding from parapodial lobes (Figs 29F, 30A, arrows), slightly oblique at tip especially in posterior parapodia, (Fig. 28D). Capillary dorsal and ventral simple chaetae absent. Pharynx slender, unarmed. Proventricle almost spherical, through 4–5 segments, with about 15 muscle cell rows. Pygidium small, slightly bilobed, with 2 short anal cirri.

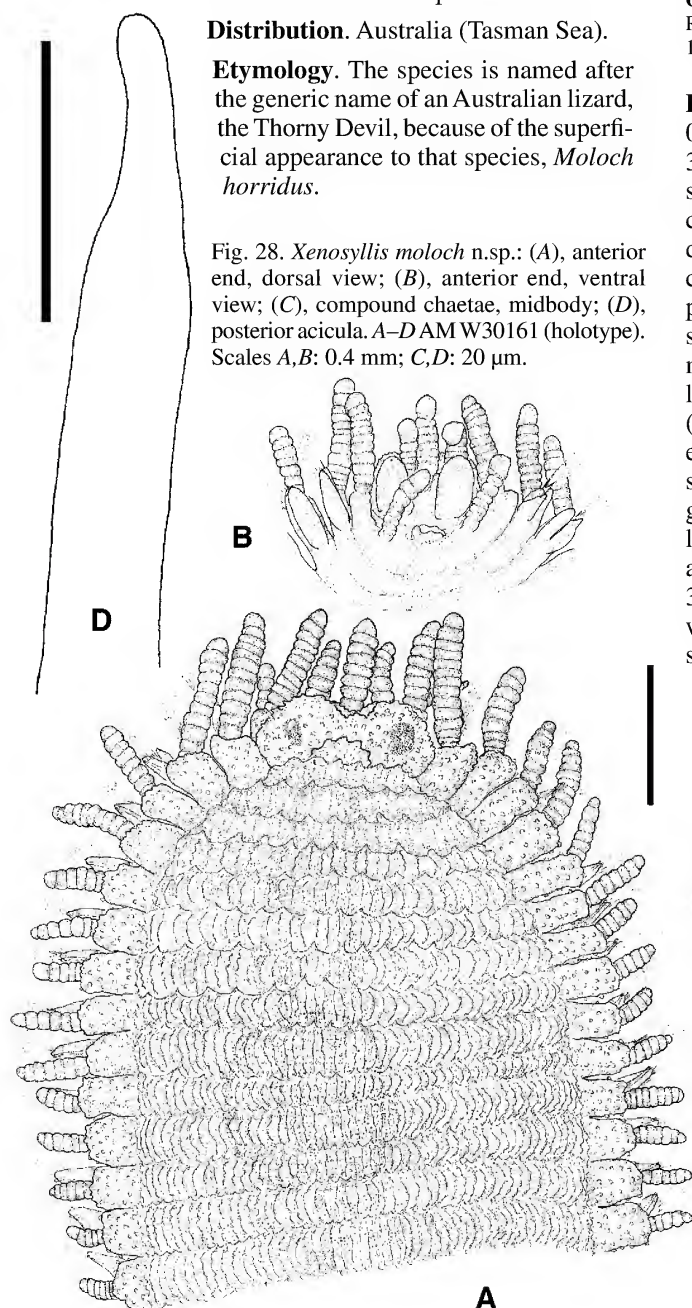
Remarks. *Xenosyllis moloch* differs from *Xenosyllis scabra* by having a broader body, with conspicuous longitudinal dorsal crests and anterior spines each with a distal pore on each segment, palps more ventrally placed, antennae and dorsal cirri without distinct longitudinal crests, and all compound chaetae bidentate; in contrast *X. scabra* has a much more slender body, segments with fewer crests, none of which end in spines; palps visible dorsally, antennae and dorsal cirri have distinct longitudinal crests, and ventralmost compound chaetae with unidentate blades.

Habitat. Occurs at depths of 244 m.

Distribution. Australia (Tasman Sea).

Etymology. The species is named after the generic name of an Australian lizard, the Thorny Devil, because of the superficial appearance to that species, *Moloch horridus*.

Fig. 28. *Xenosyllis moloch* n.sp.: (A), anterior end, dorsal view; (B), anterior end, ventral view; (C), compound chaetae, midbody; (D), posterior acicula. A–D AM W30161 (holotype). Scales A,B: 0.4 mm; C,D: 20 μ m.



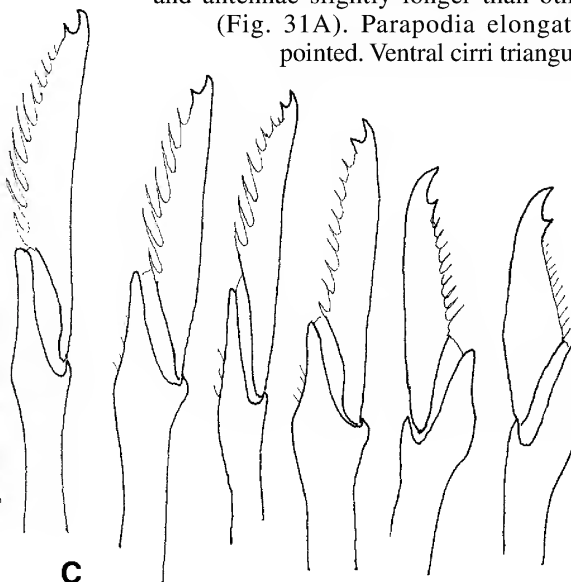
Xenosyllis scabroides n.sp.

Figs 30E,F, 31A–E, 32A–F, 33A,B

Material examined. HOLOTYPE (AM W30161) **Western Australia:** Goss Passage, Beacon Is., 28°25'30"S 113°47'E, dead plates of *Acropora* sp., covered in coralline algae, 8 m coll. P.A. Hutchings, 19 May 1994. PARATYPES: **Western Australia:** Kimberley regions Lafontaine Is., 14°10'S 125°47'E, muddy substrate with isolated coral rubble & sponges, 9–15 m, coll. P.A. Hutchings, 19 July 1988, 2 (AM W30162). Houtman Abrohos: NE entrance to Goss Passage, Beacon Is., 28°27'54"S 113°46'42"E, dead branching staghorn *Acropora* sp., coralline & brown algae, 24 m, coll. P.A. Hutchings, 25 May 1994, 1 (AM W30163). SE end of Long Is., Goss Passage, 28°28'48"S 113°46'30"E, dead coral embedded in calcareous substrate, 30 m, coll. P.A. Hutchings, 22 May 1994, 4 (AM W30164). N end of Long Is., Goss Passage, 28°28'18"S 113°46'18"E, dead coral substrate, coralline algae & boring bivalves, 8 m, coll. C. Bryce, 22 May 1994, 1 (AM W30165). Goss Passage, Beacon Is., 28°25'30"S 113°47'E, dead plates of *Acropora* sp., covered in coralline algae, 8 m, coll. P.A. Hutchings, 22 May 1994, 2 (on SEM stub), (AM W30167).

Other material examined. **Queensland:** Outer Yonge Reef, Great Barrier Reef, 14°36'S 145°38'E, coral rubble, 30 m, coll. P.A. Hutchings, 24 Jan. 1977, 1 (AM W30166).

Description. Longest examined specimen 3.7 mm long, 0.25 mm wide, with 45 chaetigers. Body flattened (Figs 30E, 31A), ribbon-like, slightly convex dorsally. Some specimens with pink cirri. Prostomium, cirrophores and cirri covered with numerous papillae (Figs 30F, 31A, 32A–C); dorsum provided with longitudinally arranged papillae and crests (Figs 30F, 31A, 32A,B). Prostomium slightly bilobed, provided with numerous papillae (Figs 30F, 31A); 4 large subdermal eyes (Fig. 31A). Antennae originating on anterior margin, at same level; median antenna with about 8 articles; lateral antennae with about 7 articles. Palps visible dorsally (Figs 30F, 31A), inserted ventrally, totally separated from each other. Nuchal organs not seen. Peristomium shorter than subsequent segments, dorsally with a triangular flap with longitudinal striations (Figs 30F, 31A); tentacular cirri slightly longer than antennae; dorsal tentacular cirri with about 7 articles; ventral tentacular cirri inserted lateroventrally (Fig. 32A), with 4–5 articles. Dorsal cirri and antennae provided with distinct crests (Figs 30F, 31A,B, 32A–C). Dorsal cirri short, inserted on distinct, strongly papillated cirrophores, with 7–9 articles; usually distal article of cirri and antennae slightly longer than others (Fig. 31A). Parapodia elongated, pointed. Ventral cirri triangular,



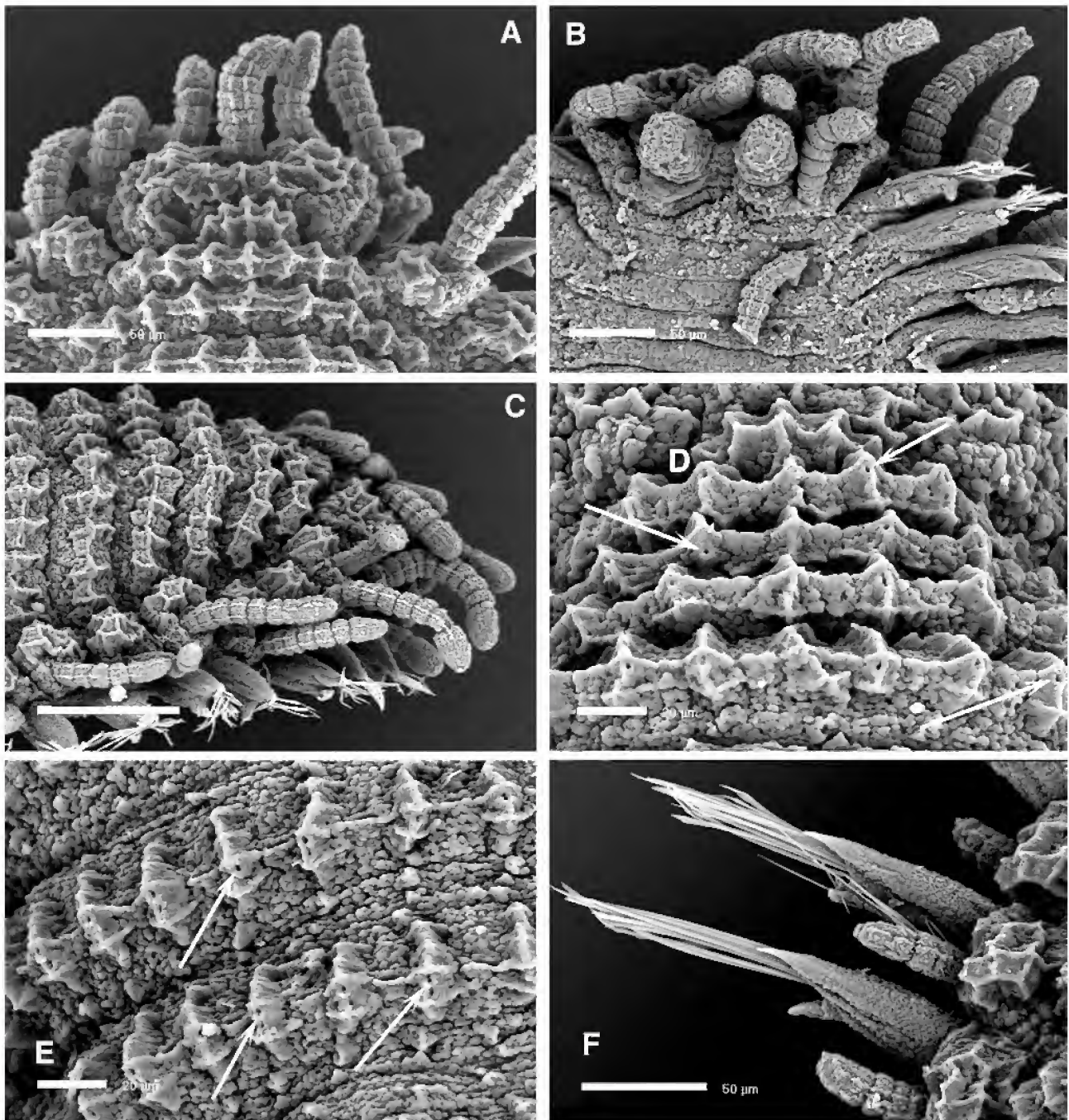


Fig. 29. SEM of *Xenosyllis moloch* n.sp.: (A), prostomium and anterior segments, dorsal view; (B), anterior end, ventral view; (C), anterior end, lateral view; (D), dorsum, with pores, anterior; (E), same, midbody; (F), midbody parapodia. A–F: AM W30160.

elongated, inserted near distal part of ventral cirri. Compound chaetae numerous, all heterogomph, bidentate falcigers, with proximal tooth smaller than distal one, and short, fine marginal spines, larger spines on superior chaetae (Figs 31C, 32D), middle and ventralmost chaetae bidentate and smooth (Figs 31C, 32E, 33A), numbering about 18 on midbody, and 8–10 posteriorly (Fig. 32F); dorsoventral gradation in length of appendages, from about 13 µm dorsally to 10 µm ventrally. Aciculae solitary, thick, sub-distally enlarged (Fig. 31E), protruding from parapodial lobes, especially on posterior parapodia, tip slightly oblique (Fig. 28D). Capillary dorsal simple chaetae absent; ventral simple chaetae slender, smooth, sigmoid, and bidentate (Figs 31D, 32F, 33A,B). Pharynx

slender in proportion to body width, unarmed (Fig. 31A), through about 6–7 segments. Proventricle almost spherical, through 2–3 segments, with about 17 muscle cell rows. Pygidium small (in proportion to pygidia present in other syllids), slightly bilobed, with 2 short anal cirri (Fig. 32B).

Remarks. *Xenosyllis scabroides* n.sp., is very similar to *Xenosyllis scabra* (Ehlers, 1864), it differs mainly in having all chaetae bidentate, whereas *X. scabra* also has unidentate, hooked compound chaetae in posterior parapodia (see San Martín, 2003, figs 167H, 168H). Campoy (1982) described *X. scabra* from different areas of the Iberian Peninsula and he commented that there were differences among specimens

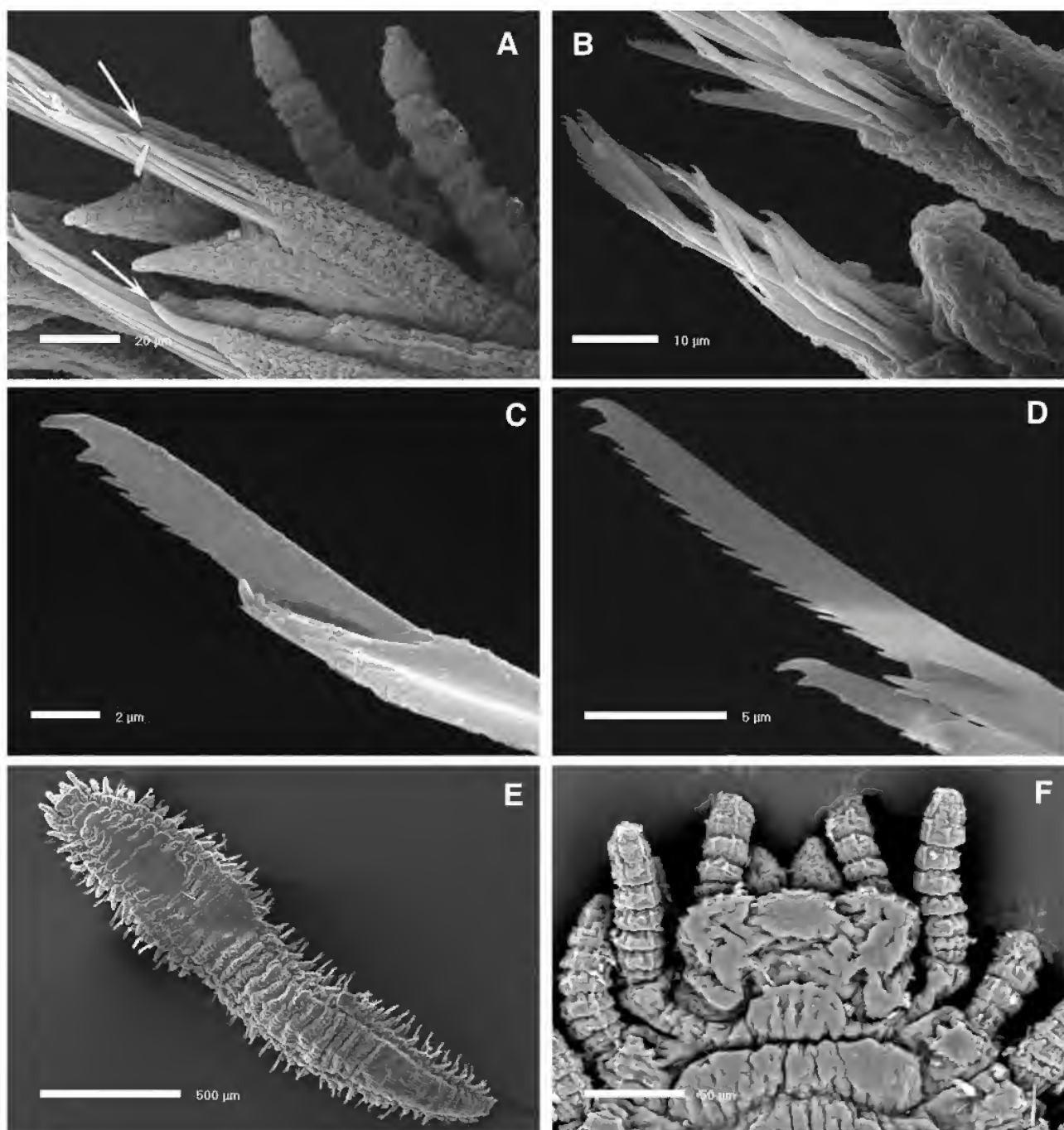


Fig. 30. SEM of *Xenosyllis moloch* n.sp.: (A) posterior parapodia; (B), midbody chaetal fascicle; (C), middle chaeta; (D), superior and inferior chaetae. SEM of *Xenosyllis scabroides* n.sp.: (E), complete specimen, dorsal view; (F), anterior end, dorsal view. A–D: AM W30160; E–F: AM W30167.

from different samples, some of them having all compound chaetae bidentate and others having the ventralmost ones unidentate, suggesting the possibility that several species were involved. All Australian specimens have bidentate compound chaetae bidentate only, with none corresponding to the typical *X. scabra* from European seas, so we consider that the Australian specimens belong to a new species. Reports of *X. scabra* from beyond the type locality should be examined as they may represent other species of the genus. *Xenosyllis scabroides* differs from *X. moloch* in the development of longitudinal crests on the antennae and dorsal cirri, and the number of these crests on mid body segments, with *X.*

moloch having more than 30 present whereas *X. scabroides* has less than 30 present. In addition *X. scabroides* occurs in 8–30 m and *X. moloch* in depths of 244 m.

Habitat. Occurs in shallow water associated with coral rubble.

Distribution. Australia (North and Central Western Australia, Queensland).

Etymology. The species is named *scabroides* because of its similarity to the type species of the genus, *Xenosyllis scabra*.

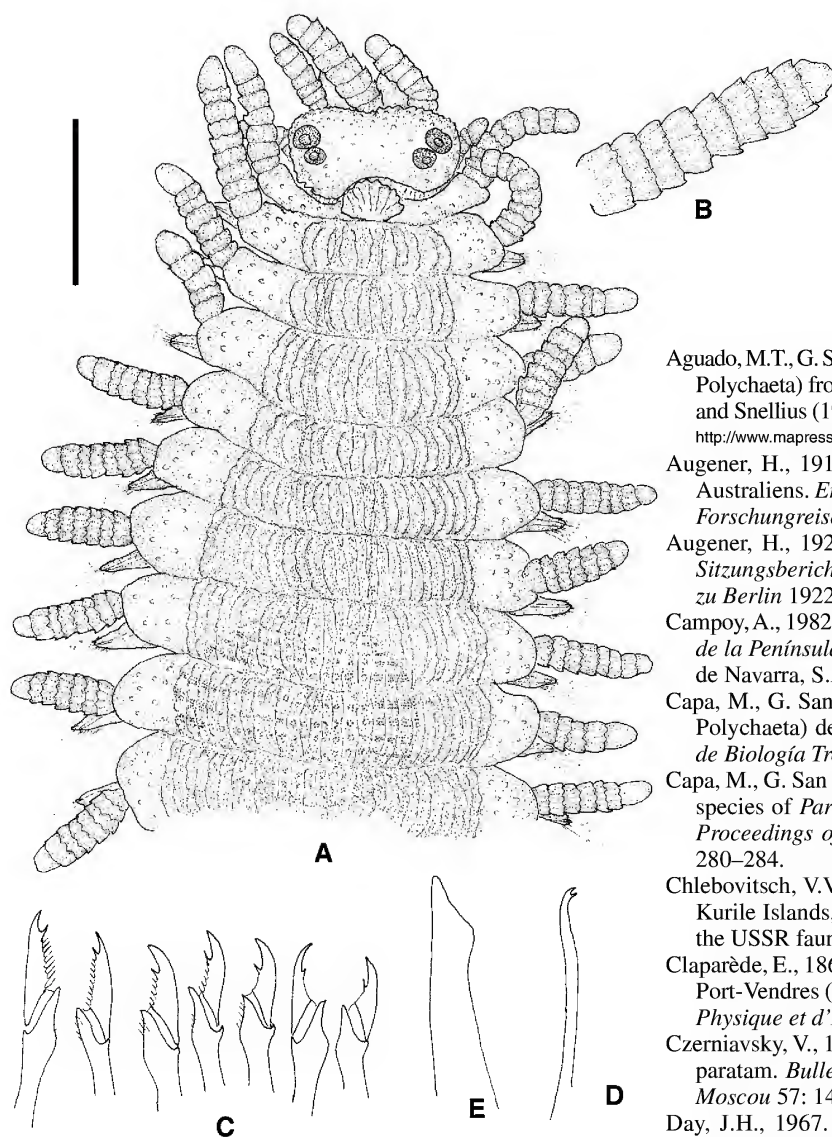


Fig. 31. *Xenosyllis scabroides* n.sp.: (A), anterior end, dorsal view; (B), dorsal cirrus; (C), midbody compound chaetae; (E), posterior acicula; (D), ventral simple chaeta. A–D: AM W30167 (paratype). Scales A: 0.18 mm; B: 92 μ m; C–E: 20 μ m.

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ACKNOWLEDGMENTS. This paper is a contribution of the project *Taxonomía y Sistemática de la Familia Syllidae (Polychaeta)*, funded by the Ministerio de Educación y Ciencia of the Spanish Government, Project number CGL2005-02442.

This project was partially financed also by the European Commission's Research Infrastructure Action via the SYNTHESIS Project.

We are grateful to Kate Attwood and Anna Murray, who did the rough sorting of the material, previously only identified to family level, and extracted the specimens of the subfamily Syllinae, and, together with Keyne Monro, managed the collection and checked the *Material examined* sections for us. We also appreciate the previous work mostly done by volunteers, of extracting syllids from benthic samples. Dr Angelika Brandt and Gisella Wegener, Zoologisches Museum of Hamburg (Germany) kindly and efficiently assisted the senior author during his stay at the Museum, which was necessary to examine type specimens to compare them with Australian material. We would also like to thank the curator of the MNHN (Tarik Meziane) and the curator of the ZMBN (Birger Neuhaus) for loaning us several type series. Finally we also want to express our gratitude to Yolanda Lucas, who drew figures 7, 14, and 18 and Dr Esperanza Salvador (SIDI of the UAM), for her assistance with the SEMs. Fig. 21 has been reproduced with the kind permission of Springer Science and Business Media. The comments and suggestions of two anonymous referees greatly improved the quality of the manuscript.

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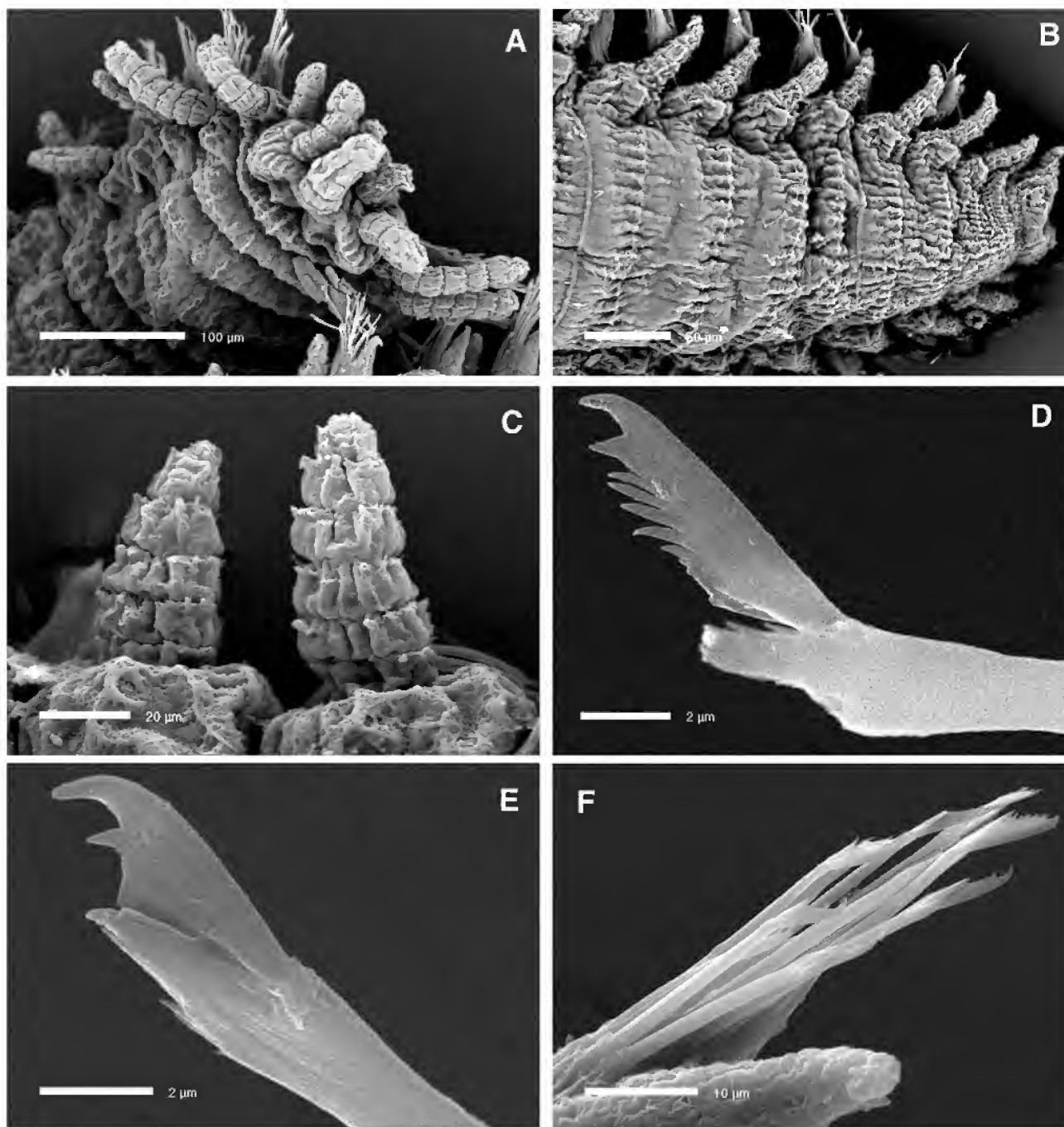


Fig. 32. SEM of *Xenosyllis scabroides* n.sp.: (A), detail of anterior end; (B), posterior end, dorsal view; (C), midbody dorsal cirri; (D), superior compound chaetae; (E), middle compound chaetae; (F), posterior chaetal fascicle. A–F: AM W30167 (paratype).

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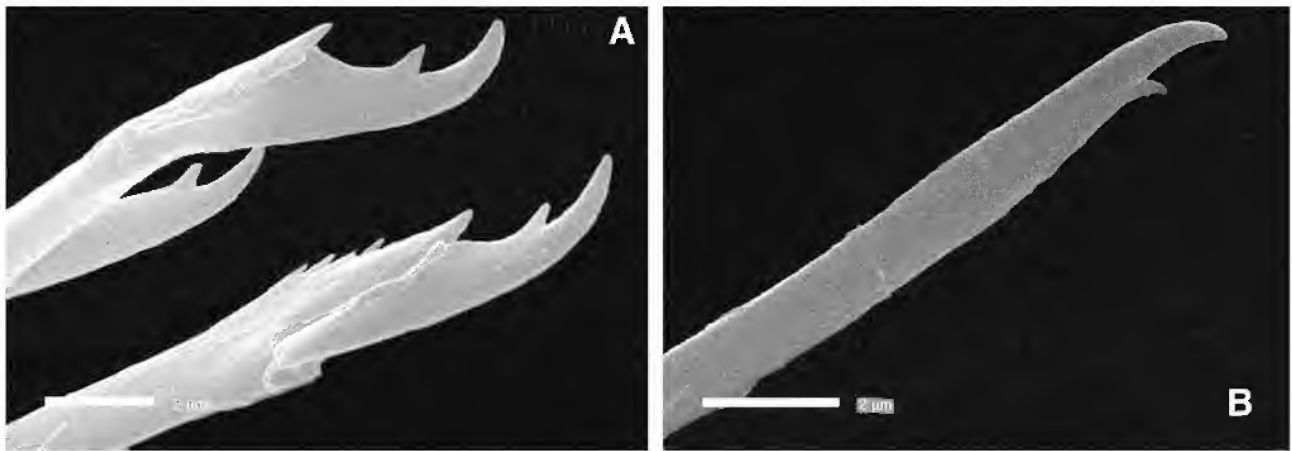


Fig. 33. SEM of *Xenosyllis scabroides* n.sp.: (A) inferior compound and ventral simple chaetae, posterior parapodium; (F), ventral simple chaeta, posterior parapodium. A–B: AM W30167 (paratype).

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Manuscript submitted 19 February 2007, revised 21 February 2008, and accepted 15 March 2008.

Associate Editor: G.D.F. Wilson.

The Coastal Talitridae (Amphipoda: Talitroidea) of Southern and Western Australia, with Comments on *Platorchestia platensis* (Krøyer, 1845)

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ABSTRACT. A total of eight coastal talitrid amphipods from Victoria, South Australia and Western Australia are documented. Three new genera (*Australorchestia* n.gen.; *Bellorchestia* n.gen. and *Notorchestia* n.gen.) and seven new species (*Australorchestia occidentalis* n.sp.; *Bellorchestia richardsoni* n.sp.; *Notorchestia lobata* n.sp.; *N. naturaliste* n.sp.; *Platorchestia paraplatisensis* n.sp. *Protorchestia ceduna* n.sp. and *Transorchestia marlo* n.sp.) are described. *Notorchestia australis* (Fearn-Wannan, 1968) is reported from Twofold Bay, New South Wales, to the Eyre Peninsula, South Australia. Seven Australian and New Zealand “*Talorchestia*” species are transferred to *Bellorchestia*: *B. chathamensis* (Hurley, 1956); *B. kirki* (Hurley, 1956); *B. marmorata* (Haswell, 1880); *B. pravidactyla* (Haswell, 1880); *B. quoyana* (Milne Edwards, 1840); *B. spadix* (Hurley, 1956) and *B. tumida* (Thomson, 1885). Two Australian “*Talorchestia*” species are transferred to *Notorchestia*: *N. australis* (Fearn-Wannan, 1968) and *N. novaehollandiae* (Stebbing, 1899). Type material of *Platorchestia platensis* and *Protorchestia lakei* were re-examined for comparison with Australian species herein described. A key to the species herein described is provided.

SEREJO, C.S., & J.K. LOWRY, 2008. The coastal Talitridae (Amphipoda: Talitroidea) of southern and western Australia, with comments on *Platorchestia platensis* (Krøyer, 1845). *Records of the Australian Museum* 60(2): 161–206.

The family Talitridae includes about 250 species distributed in 52 genera, being the only amphipod group that has colonized terrestrial habitats. Coastal talitrids reported herein include species living by the sea on beaches, in estuarine areas, and even fully freshwater streams. Worldwide they include about 22 genera represented by the marsh-hoppers, beach-hoppers, and sand-hoppers. The fourth ecological group within the Talitridae, the land-hoppers, can be found near the sea or at high altitudes, but they inhabit the forest-floor litter, and are considered truly terrestrial. Definitions of

these four ecological groups were first proposed by Bousfield (1982, 1984) and are currently used in the literature, although they do not reflect monophyletic groups.

Australian land-hoppers are relatively well known from the works of Friend (1979, 1982, 1987). Richardson *et al.* (1991, 1997) and Richardson & Mulcahy (1996) showed the zonation of species, including land-hoppers, along Tasmanian coastlines. More recently, Peart & Lowry (2006) described six new land-hoppers from New South Wales. Land-hoppers will not be considered further in this study.

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The first genera established to include coastal talitrids were *Orchestia* Leach, 1793, *Talitrus* Latreille, 1802, *Orchestoidea* Nicolet, 1849, and *Talorchestia* Dana, 1852. Until Bousfield's revisions (1982, 1984) most coastal species were identified within these genera. However, line drawings at that time were insufficient to define these groups, especially between *Orchestia* and *Talorchestia*, leading to the current difficulties (Hurley, 1956; Morino & Miyamoto, 1988). Bousfield (1982) revised part of the coastal talitrids based on material from the northeastern Pacific coast. The *Orchestia* complex was subdivided into six genera, and the *Orchestoidea* complex into four genera. *Uhlorchestia* was erected to include some of the marsh-hopper species from the Atlantic coast of North America (Bousfield & Heard, 1986). The *Talorchestia* complex was not considered at that time.

Morino and Miyamoto (1988) proposed a redefinition of *Talorchestia* (*sensu stricto*), that included the type species, *T. gracilis* (Dana, 1852), plus *T. spinipalma* (Dana, 1852), *T. martensii* (Weber, 1892) and *T. palawanensis* Morino & Miyamoto, 1988. Subsequently, Miyamoto & Morino (1999) included a fifth species, *T. mindorensis* Olerod, 1970. Although this new definition may be correct, it is incomplete because it leaves the remaining species of *Talorchestia* (*sensu lato*) without a generic name. Later, Bousfield (1991) treated some sand-hoppers species from the Gulf of Mexico and erected *Americorchestia*, including part of the *Talorchestia* species to this new genus. Serejo (2004) created *Atlantorchestoidea* to include the common, highly adapted Brazilian sand-hopper from open beaches, *A. brasiliensis* (Dana, 1853). Ruffo (in Tafani *et al.*, 2004) proposed two new genera, *Deshayesorchestia* and *Sardorchestia*, for Mediterranean species of *Talorchestia* (*sensu lato*) based on molecular analysis. Some *Talorchestia* (*sensu lato*) species have also been transferred to new genera (*Notorchestia* and *Bellorchestia*) in this study. At this point 26 species of *Talorchestia* (*sensu lato*) remain unplaced.

Although quite common on Australian beaches and in mangrove areas, knowledge of the coastal Australian talitrid fauna is scattered and based mainly on works from the 19th century. Of the 42 known Talitridae species in Australia, 14 are recorded for the coastal zones, all from the eastern or southern coasts (Lowry & Stoddart, 2003). There were no records of talitrids from the Northern Territory or from Western Australia until this study.

Dana (1852) was the first to describe talitrid species from Australia, recording two species of *Orchestia* from New South Wales (NSW), *O. dispar* and *O. quadrimanus*. Haswell (1879; 1880) studied material from Queensland, New South Wales and Tasmania, and described six additional species of *Orchestia* and *Talorchestia*: *O. macleayana* Haswell, 1879; *O. marmorata* Haswell, 1880; *T. diemenensis* Haswell, 1879; *T. limicola* Haswell, 1880; *T. pravidactyla* Haswell, 1880 and *T. terraereginae* Haswell, 1880. Stebbing (1899) described *T. novaehollandiae* from New South Wales. More recently, Fearn-Wannan (1968) described *Orchestia australis* from Victoria; Marsden & Fenwick (1984) described a new genus and species, *Chroestia lota*, from Queensland; Richardson

(1993) described two new species of estuarine talitrids, *Eorchestia palustris* and *E. rupestris* from Tasmania and Richardson (1996) described *Protorchestia lakei* also from Tasmania. Morino & Miyamoto (1988) recorded *Talorchestia palawanensis* (Morino & Miyamoto, 1988) from Thursday Island, Queensland, and *T. spinipalma* (Dana, 1852) from Port Denison, Queensland. However, the Australian record of *T. spinipalma* is based on a synonymy proposed by Stebbing (1906), who considered *T. terraereginae* Haswell (1880), type locality, Port Denison, Queensland, to be a junior synonym of *T. spinipalma*, type locality, Tongatabu, Tonga. This study is a step in the improvement of the knowledge of the Australian coastal talitrids.

Methods

Aside from the work of Alastair Richardson in Tasmania, there have been no comprehensive collections of Australian coastal talitrids. Between 8 October and 6 November 2003, we drove along the southern Australian coastline making 65 collections from 18 sites in Victoria, 21 sites in South Australia and 26 sites in Western Australia as far north as Exmouth Gulf. We collected eight species from exposed and sheltered beaches, mangroves and marshes in what became known as the "Australian National Talitrid Survey" (ANTS 1). Only one of the eight species had been reported earlier for this area.

For each collection, some of the specimens were fixed in 10% formalin and some were fixed in 95% ethanol. Formalin-fixed specimens were prepared for SEM as follows. Dissected parts were cleaned, taken through alcohol up to 100%, critical point dried, mounted individually on aluminium stubs using carbon double-adhesive tape and gold sputter coated. They were then imaged on a LEO 435 VP scanning electron microscope. Digital images were taken with a Hotshot camera connected to a computer. Images were prepared for plates using *Adobe Photoshop*. Line draw plates were done using a stereomicroscope with camera lucida. Scale bars of plates 4, 8, 12, 16, 20, 24, 26, and 33 were given only to one structure of a group of pieces. So, the scale given to one of the oostegites should be considered to the others, to one of the branchiae should be considered to the others and to one of the pleopods should be considered to the others. Material from these collections is deposited in the Australian Museum, Sydney (AM), the Museu Nacional, Rio de Janeiro (MN RJ), Museum Victoria, Melbourne (NMV) and the Zoological Museum, Copenhagen (ZMUC), and forms the basis of this study.

The taxonomic descriptions and diagnoses presented in this paper were generated from a DELTA (Dallwitz, 2005) database to world talitrid genera and species. The following abbreviations are used on the plates: **A**, antenna; **Art**, article; **BR**, branchiae; **EP**, epimeron; **G**, gnathopod; **LL**, lower lip; **MD**, mandible; **MP**, maxilliped; **MX**, maxilla; **O**, oostegite; **P**, pereopod; **PL**, pleopod; **T**, telson; **UL**, upper lip; **U**, uropod; **l**, left; **r**, right. Abbreviations in the text are as follows: **NSW**, New South Wales; **SA**, South Australia; **VIC**, Victoria; **WA**, Western Australia.

Systematics

Key to coastal talitrid species of Victoria, South Australia and Western Australia

- 1 Pereopods 3–7 simplidactylate; dactylus of pereopod 4 similar to that of pereopod 3 (Figs 27, 28) *Protorchestia ceduna* n.sp.
 — Pereopods 3–7 cuspidactylate; dactylus of pereopod 4 variously thickened, unlike that of pereopod 3 2
- 2 Antenna 2 geniculate; gills 2–6 simple, sac-like and similar in size; uropod 1 peduncle with distolateral robust seta; uropod 2 outer ramus without marginal setae (Figs 1, 3, 4) *Australorchestia occidentalis* n.sp.
 — Antenna 2 not geniculate; gills 2–6 lobate and/or convoluted, gills 3–5 smaller than gills 2 and 6; uropod 1 peduncle without distolateral robust seta; uropod 2 outer ramus with marginal robust setae 3
- 3 Epistome with robust setae; uropods 1–2 peduncle with ventral robust setae; telson broader than long (Figs 5, 7) *Bellorchestia richardsoni* n.sp.
 — Epistome without robust setae; uropods 1–2 peduncle without ventral robust setae; telson longer than broad 4
- 4 Left lacinia mobilis 5-dentate; outer ramus of uropod 1 without setae (Figs 21, 23) *Platorchestia paraplatensis* n.sp.
 — Left lacinia mobilis 4-dentate (rarely 5-dentate); outer ramus of uropod 1 with setae 5
- 5 Male antenna 2 peduncle enlarged; article 2 of maxilliped palp without lobe; oostegites 2–5 curl-tipped setae; telson slightly emarginate (Figs 30, 32, 33) *Transorchestia marlo* n.sp.
 — Male antenna 2 peduncle not enlarged; article 2 of maxilliped palp with lobe; oostegites 2–5 with simple or multi-furcate tip setae; telson cleft to half length (Figs 9, 11, 12) (*Notorchestia*) 6
- 6 Antenna 2 with many robust setae; female and juvenile male gnathopod 2 merus with posterodistal hook-like process on medial surface; pereopod 7 basis with lateral sulcus (Figs 13–15) 7
 — Antenna 2 with few robust setae; female and juvenile male gnathopod 2 merus without posterodistal hook-like process on medial surface; pereopod 7 basis without lateral sulcus (Figs 9–11) *Notorchestia australis*
- 7 Adult male gnathopod 2 propodus sub-quadrate; palm slightly acute to transverse, with large midpalmar concavity; male pereopod 7 basis with posteroventral lobe, but lacking frontal rounded lobe; peduncle of pleopod 1 with medial robust setae (Figs 14, 16) *Notorchestia lobata* n.sp.
 — Adult male gnathopod 2 propodus sub-triangular; palm acute, sinuous, with small midpalmar concavity; male pereopod 7 basis without posteroventral lobe, but with frontal rounded lobe; peduncle of pleopod 1 without medial robust setae (Figs 18, 20) *Notorchestia naturaliste* n.sp.

Australorchestia n.gen.

Type species. *Australorchestia occidentalis* n.sp.

Etymology. The name is a combination of Australia and the generic name *Orchestia*.

Diagnosis. Antenna 2 geniculate, sexually dimorphic, male peduncle slightly enlarged when compared with female. Mandible left lacinia mobilis 4-dentate. Maxillipedal

palp dactylus present, reduced. Gnathopod 2 subchelate; basis narrow; propodus palm posterodistal corner without protuberance; dactylus attenuated distally. Pereopods 3–7 cuspidactylate. Pereopod 4 carpus significantly shorter than carpus of pereopod 3. Pereopod 6 not sexually dimorphic. Pereopod 7 sexually dimorphic or not, distal articles (merus and carpus) slightly expanded in terminal males; basis lateral sulcus absent. Gills simple, sac-like and similar in size. Oostegites 2–5 setae with simple straight tips. Pleopods all well developed. Uropod 1 outer ramus with lateral marginal

Table 1. Morphological differences among 4-dentate cuspidactylate beach-hopper genera. Abbreviations given on p. 162.

	<i>Australorchestia</i> n.gen.	<i>Chroestia</i> Mardsen & Fenwick, 1984	<i>Floresorchestia</i> Bousfield, 1984	<i>Orchestia</i> Leach, 1813–1814	<i>Tethorchestia</i> Bousfield, 1984	<i>Transorchestia</i> Bousfield, 1982
A2 article 2 of MP palp	geniculate without lobe medially	not geniculate with well-devel- oped lobe	geniculate with small or without lobe*	not geniculate with well- developed lobe	geniculate with small or without lobe attenuated	not geniculate with well- developed lobe not attenuated
G2 male dactylus	strongly attenuated distally	strongly atten- uated distally	attenuated	not attenuated		
G2 female basis	slender	expanded	slightly expanded	expanded	expanded antero- proximally	slightly expanded
merus and carpus of male adult P7	slightly expanded	expanded	slender	expanded	slender	expanded
submarginal row of pits on EP2–3	absent	absent	present	absent	absent	absent
U1 distolateral robust setae	present, well developed	present, well developed	usually developed	weak/lacking	present, well developed	lacking
U1 outer ramus margins	with 1–3 setae	lacking setae	lacking setae ^a	with at least 1 seta	lacking setae	with setae
U2 outer ramus margin	lacking setae	with 1 seta	with at least 1 seta	with at least 1 seta	with 2 setae	with at least 1 seta
Oostegites setae	simple	curl-tipped	simple	simple	simple	curl-tipped
coxal gills 2–6 distribution	subequal in size tropical western Australia	2, 6 largest tropical eastern Australia (QLD)	? tropical and warm- temp. Indo-Pacific and Caribbean Sea	2, 6 largest Atlantic-Medi- terranean Sea	2, 6 largest Caribbean Sea and adjacent Western Atlantic seashore and estuarine	2, 6 largest New Zealand and northeastern Pacific (California, Lake Merritt)
habitat	mangroves and clayey mudflats	estuarine	mostly terrestrial	seashore with few terrestrial spp.	one terrestrial sp.	

^a occasionally with an “amplexing” seta on male; * Bousfield (1984) did not state this character in the formal description of the genus, although figures of *F. anomala* and *F. pectinispina* indicate absence or a very small lobe respectively (Bousfield, 1971: 272, fig. 9 and 278, fig. 12).

robust setae. Uropod 2 outer ramus without marginal robust setae. Telson longer than broad with 3–5 robust setae per lobe.

Species composition. *Australorchestia occidentalis* n.sp.

Remarks. Despite the uncommon, mud clayey habitat in which *Australorchestia occidentalis* n.sp. was found, some specimens were also found inhabiting mangrove areas. This habitat suggests that *Australorchestia* could be one of the more basal palustral genera proposed by Bousfield (1984). Some similarities with the palustral genera are: left lacinia mobilis 4-dentate, article 2 of maxilliped palp not lobate medially; and gills 2–6 similar, simple and sac-like. However, *Australorchestia* has the maxilliped palp obscurely 4-articulate, dactyli of pereopods 3–7 are distinctly cuspidactylate, and the telson has lateral and distal setae, characters not present in the palustral genera described by Bousfield (1984). *Australorchestia* has pereopods and the peduncles of pleopods poorly setose, suggesting that this genus is possibly closely related to Bousfield’s (1982, 1984) 4-dentate cuspidactylate beach-hopper genera. Comparisons between these genera are given in Table 1. Although similar in some aspects to the other five known, 4-dentate, cuspidactylate beach-hopper genera, *Australorchestia* can be generally distinguished by a combination of characters and more specifically by the unexpanded basis of female gnathopod 2, coxal gills 2–6 subequal in size and sac-like, and lack of marginal setae on the outer ramus of uropod 2.

Australorchestia occidentalis n.sp.

Figs 1–4

Type material. HOLOTYPE: male 11.6 mm AM P69130 (1 slide, stubs J053–J055, J057–J059). PARATYPES: male 11.3 mm (habitus) AM P69153 (stub J060); 1 female 6.3 mm AM P69130 (1 slide, stub J056, SEM micrographs); 9 males and 12 females, AM P69132, mangroves near mouth of Gascoyne River (end of Harbour Road), Carnarvon, Western Australia (24°54.2'S 113°38.96'E), small mangrove area with dead seagrasses among roots and pneumatophores and some stones on sand substrate, C. Serejo & J.K. Lowry, 30 Oct. 2003.

Type locality. Mangroves near mouth of Gascoyne River (end of Harbour Road), Carnarvon, Western Australia (24°54.2'S 113°38.96'E), small mangrove area with dead seagrasses among roots and pneumatophores and some stones on sand substrate, C. Serejo & J.K. Lowry, 30 Oct. 2003, WA 768.

Additional material examined. *Western Australia:* 1 male and 9 females, AM P69133, Mangrove Bay, Cape Range National Park, (22°08'S 113°59'E), low thick mangroves in a sheltered bay, C. Serejo & J.K. Lowry, 31 Oct. 2003, WA 770; 14 males and 27 females (some ovigerous), AM P69134, Disappointment Loop, Henri Freycinet Harbour, Shark Bay (26°40.21'S 113°40.31'E), low rock platform moving into clayey mudflats with small banks covered

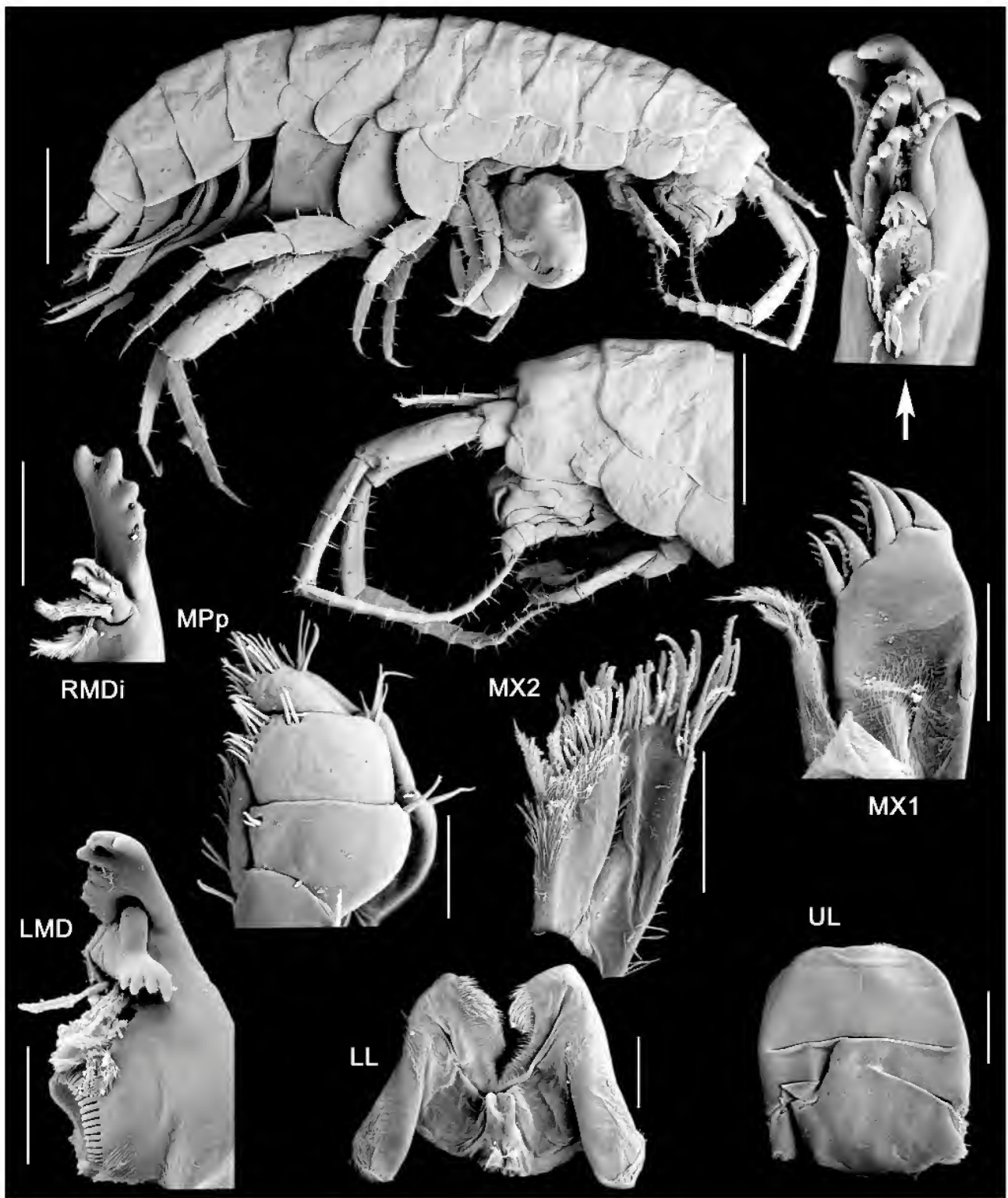


Fig. 1. *Australorchestia occidentalis* n.sp., paratype male, 11.3 mm, habitus, AM P69153; holotype male, 11.6 mm, other parts, AM P69130, Gascoyne River, Carnarvon, Western Australia. Scales for habitus: 1 mm; head: 0.2 mm; remainder: 0.1 mm.

in holes interspersed with small smooth clay channels, C. Serejo & J.K. Lowry, 4 Nov. 2003, WA 775.

Etymology. The specific name refers to the endemic locality of this species from western Australia.

Diagnosis. As for the genus.

Description

Male, 11.6 mm. Eye medium, $\frac{1}{5}$ – $\frac{1}{3}$ head length. Antenna 1 short, rarely longer than peduncle article 4 of antenna 2. Antenna 2 shorter than head and first 3 pereonites; geniculate at flagellum; peduncular articles slightly expanded; with sparse, small robust setae; article 5 subequal to article

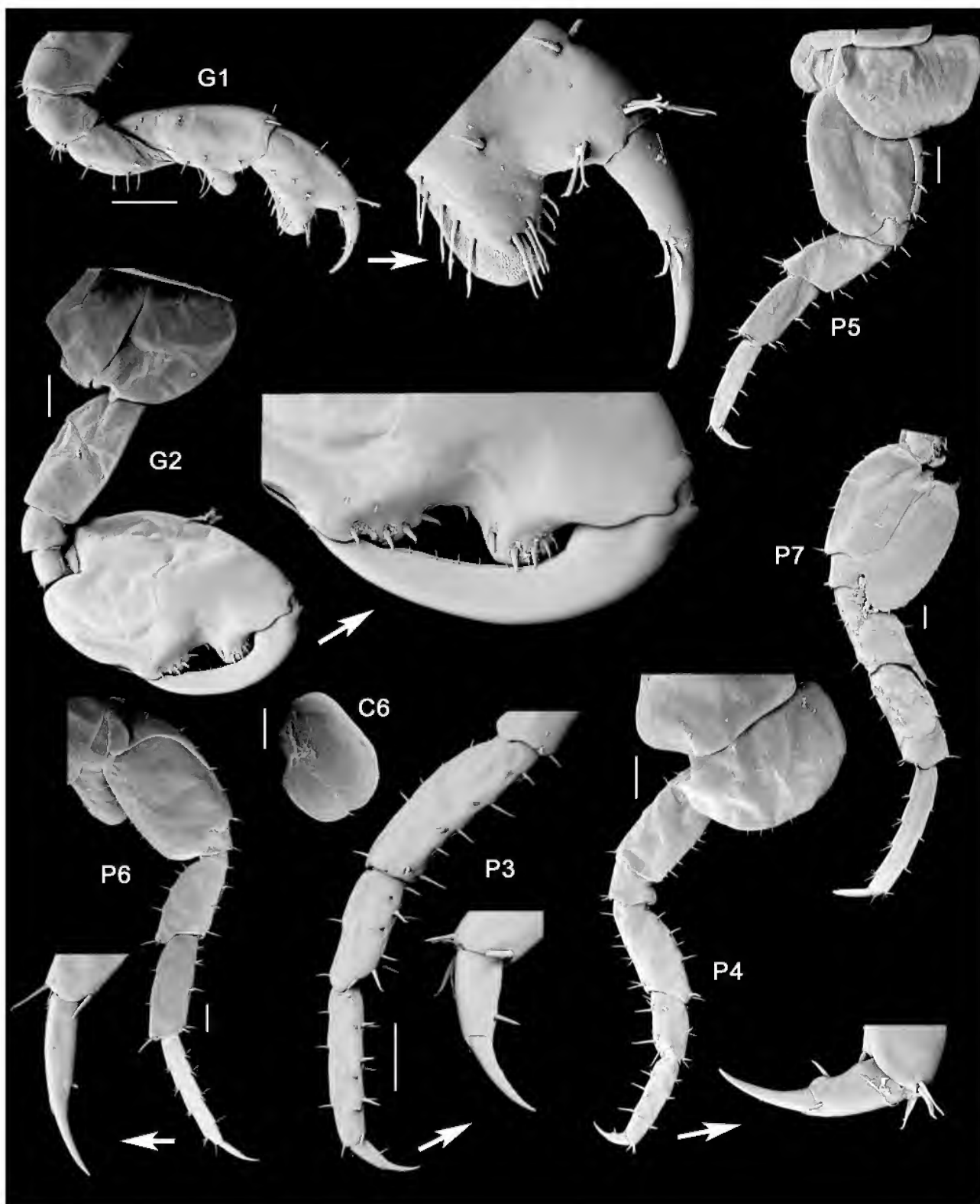


Fig. 2. *Australorchestia occidentalis* n.sp., holotype male, 11.6 mm, AM P69130, Gascoyne River, Carnarvon, Western Australia. Scales represent 0.2 mm.

4. Epistome of upper lip without robust setae. Lower lip distolateral setal tuft present. Mandible left lacinia mobilis 4-dentate. Maxilliped palp article 2 without distomedial lobe, article 4 present, reduced.

Gnathopod 1 subchelate; posterior margin of carpus and propodus with rugose lobe; propodus sub-triangular;

palm strongly excavated, transverse; dactylus subequal in length to palm, without ventral setal row, simplidactylate. Gnathopod 2 subchelate; palm acute, with subquadrate protuberance near dactylar hinge and large midpalmar sinus, posterodistal corner without enlarged protuberance; dactylus longer than palm, attenuated distally. Coxae 2–4 as wide as

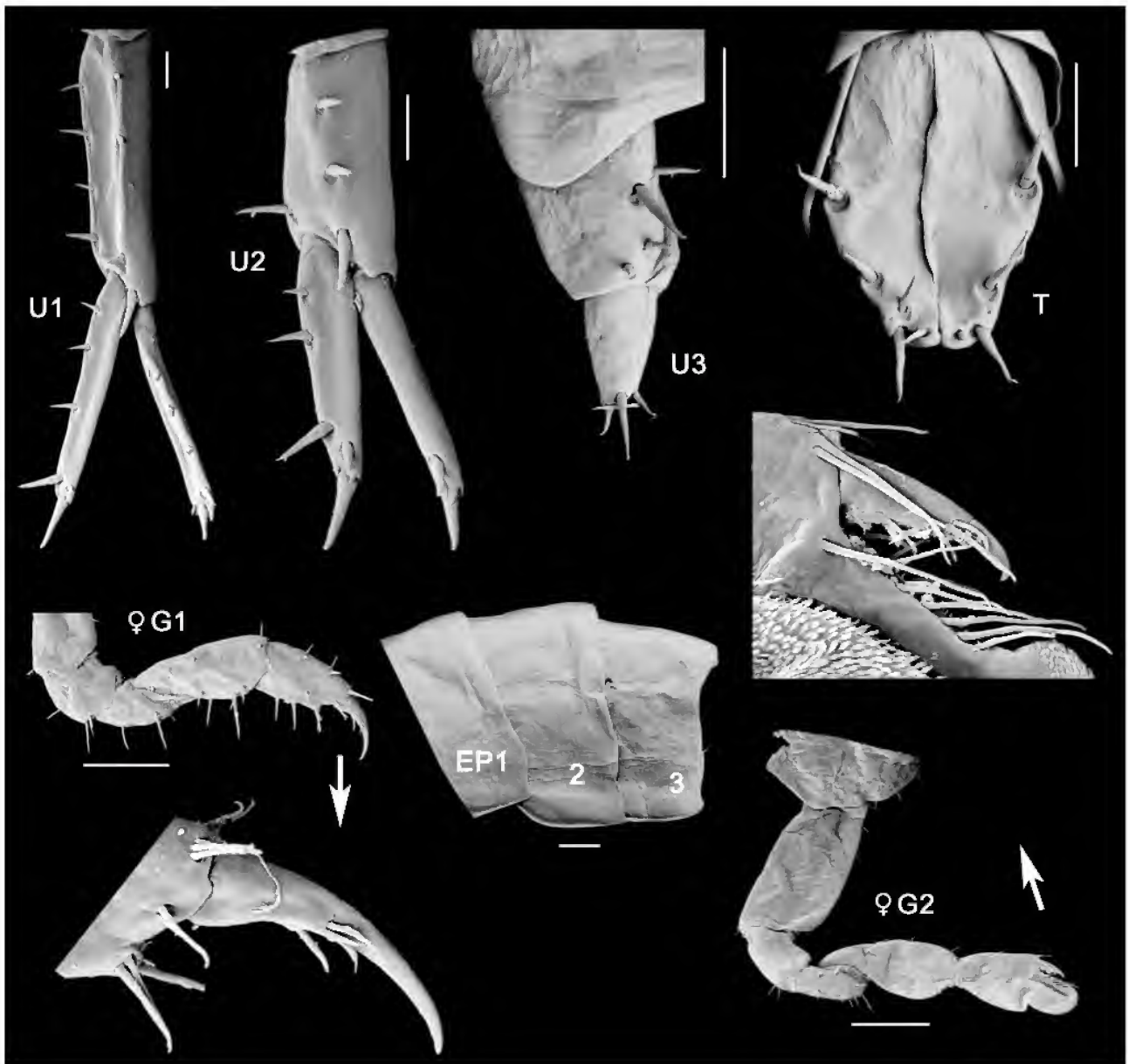


Fig. 3. *Australorchestia occidentalis* n.sp., holotype male, 11.6 mm, U1–3, T, EP1–3, AM P69130; paratype female, 6.3 mm, G1–2, AM P69130, Gascoyne River, Carnarvon, Western Australia. Scales for U1–3, T: 0.1 mm; remainder: 0.2 mm.

deep. Pereopods 3–7 cuspidactylate; dactylus without row or patch of dorsal short setae. Pereopod 4 dactylus slightly thickened and pinched posteriorly, different to pereopod 3 dactylus. Pereopod 5 propodus longer than carpus. Pereopod 6 not sexually dimorphic; shorter than pereopod 7; coxa posterior lobe anterodistal corner rounded, with 1 marginal seta, posterior margin perpendicular to ventral margin, outer surface with ridge. Pereopod 7 sexually dimorphic; basis without lateral sulcus, posterodistal lobe present; distal articles (merus and carpus) slightly expanded in terminal males; carpus sub-rectangular. Coxal gills 2–6 simple or slightly lobate and subequal in size.

Pleopods 1–3 well developed, biramous. Pleopods 1–2 peduncle without marginal setae. Pleopod 3 peduncle with one marginal slender seta. Epimeron 2 subequal in length to epimeron 3. Epimeron 2–3 posterior margin smooth, with one tiny seta faraway from the corner, posteroventral corner with small subacute spine, ventral margin without robust

setae. Uropod 1 peduncle with 7 robust setae in two rows; distolateral robust seta present, small, less than 1/4 length of outer ramus; inner ramus subequal in length to outer ramus, with 3 marginal robust setae; outer ramus with 2–3 marginal robust setae. Uropod 2 peduncle with 4 robust setae in two rows; inner ramus subequal in length to outer ramus, with 2 marginal robust setae; outer ramus without marginal robust setae. Uropod 3 peduncle with 4 robust setae; ramus slightly shorter than peduncle, oval to spatula-shape, broad distally, without marginal setae and with 4–5 apical setae. Telson longer than broad; entire; dorsal midline entire; with marginal and apical robust setae; about 3 to 5 robust setae per lobe.

Female (sexually dimorphic characters). 6.3 mm. Antenna 2 peduncular articles narrow. Gnathopod 1 parachelate, with very short palm surpassed by dactylus; propodus ovoid; palm very short, acute; dactylus longer than palm. Gnathopod 2 basis narrow; about 3.2× longer than wide, palm

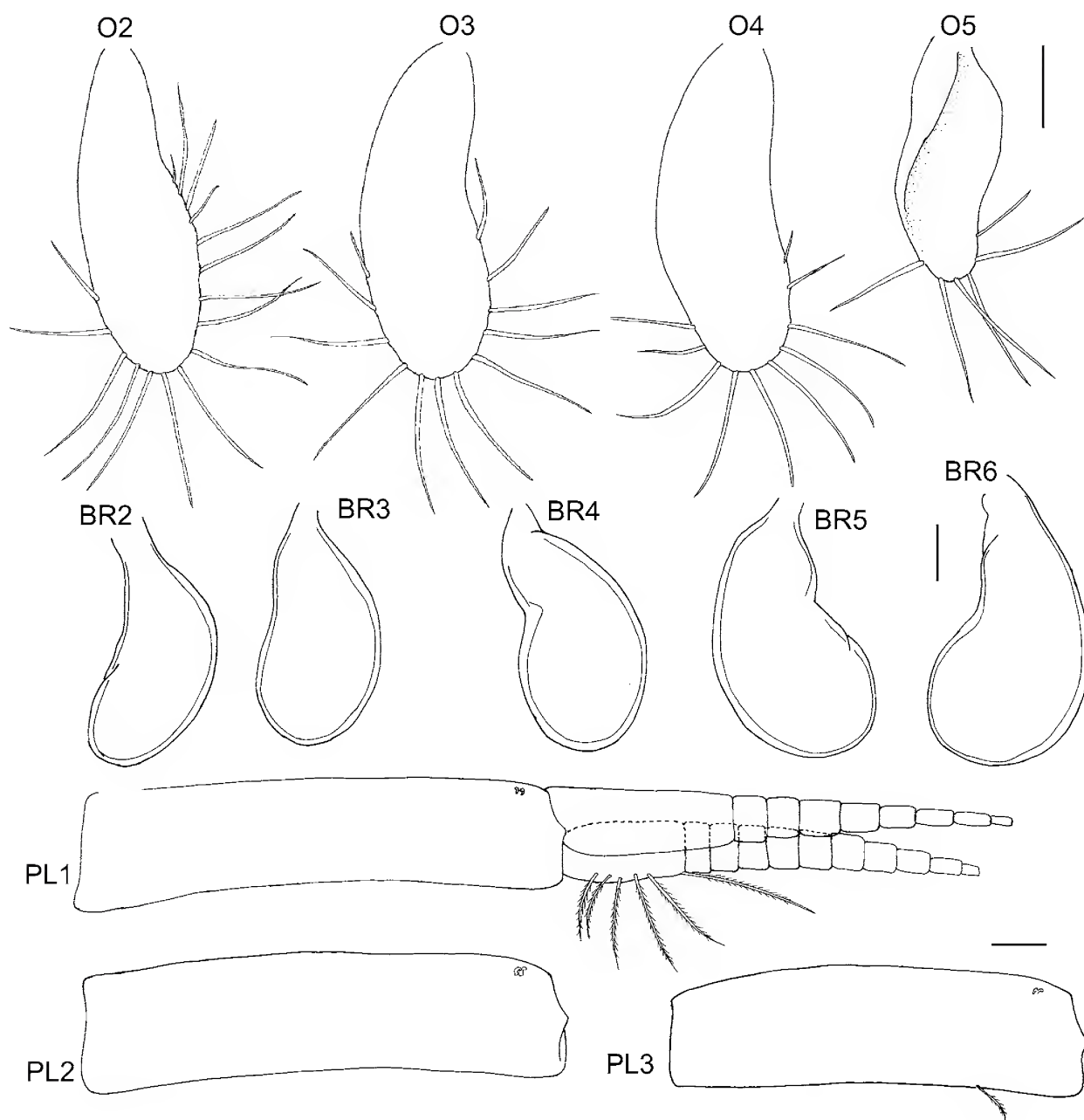


Fig. 4. *Australorchestia occidentalis* n.sp., holotype male, 11.6 mm, PL1–3; BR2–6, AM P69130; paratype female, 6.3 mm, O2–5, AM P69130. Scales for PL1–3 and BR2–6: 0.1 mm; remainder: 0.2 mm.

obtuse; dactylus shorter than palm. Pereopod 7, merus and carpus slender. Uropod 1 outer ramus with 1 marginal seta. Oostegites longer than wide; setae with simple straight tips. Oostegites 2–5 weakly setose (from 6 to 15 setae).

Habitat. Marsh-hoppers living on mud of mangroves and on a clayey mudflat of a salty embayment of Shark Bay, WA.

Remarks. See discussion of *Australorchestia* and Table 1.

Distribution. *Western Australia:* Mouth of Gascoyne River, Carnarvon; Disappointment Loop, Henri Freycinet Harbour, Shark Bay; Mangrove Bay, Cape Range National Park.

***Bellorchestia* n.gen.**

Talorchestia Dana, 1852: 851.–Stebbing, 1906: 543 (partim.).–Stephensen, 1948: 7 (partim.).–Hurley, 1956: 359 (partim.).

Type species. *Bellorchestia richardsoni* n.sp.

Etymology. *Bella* means beautiful and refers to the general appearance of species in the genus, attached to the stem *Orchestia* from the Greek *orchestes* = dancer.

Diagnosis. Antenna 2 not geniculate and not sexually dimorphic. Mandible left lacinia mobilis 5-dentate. Maxillipedal palp dactylus present, reduced. Male gnathopods 1–2 subchelate; male gnathopod 2 basis narrow; propodus palm posterodistal corner defined by large protuberance; dactylus not attenuated distally. Pereopods 3–7 cuspidactylate. Pereopod 4 carpus significantly shorter than carpus of pereopod 3. Pereopods 6–7 sexually dimorphic, merus and carpus slightly more robust in terminal males. Pereopod 7 basis lateral sulcus present, slightly pronounced. Gills lobate and/or convoluted; gills 3–5 smaller than gills 2 and 6. Oostegites 2–5 setae with simple straight tips. Pleopods all well developed. Uropods 1–2 outer rami with marginal robust setae. Telson broader than long with more than 10 robust setae.

Species composition. *Bellorchestia* contains 7 species: *B. chathamensis* (Hurley, 1956); *B. kirki* (Hurley, 1956); *B. marmorata* (Haswell, 1880); *B. pravidactyla* (Haswell, 1880); *B. quoyana* (Milne Edwards, 1840); *B. richardsoni* n.sp.; *B. spadix* (Hurley, 1956) and *B. tumida* (Thomson, 1885).

Remarks. We have tentatively placed some of the remaining “*Talorchestia*” species from Tasmania and New Zealand into *Bellorchestia*. However, some diagnostic characters of *Bellorchestia* were not described in the respective literature. Re-examination of local material would clarify the identification of these taxa.

Bellorchestia is part of the so called sand-hopper group, which are large, strongly setose talitrids adapted for burrowing, also known as substrate modifiers (Bousfield, 1982). Eleven genera are included in this group: *Americorchestia* Bousfield, 1991, *Atlantorchestoidea* Serejo, 2004, *Bellorchestia* n.gen., *Deshayesorchestia* Ruffo, 2004, *Megalorchestia* Brandt, 1851, *Orchestoidea* Nicolet, 1849, *Pseudorchestoidea* Bousfield, 1982, *Sardorchestia* Ruffo, 2004, *Talitrus* Latreille, 1802, *Talorchestia* Dana, 1852 (*sensu stricto*), and *Trinorchestia* Bousfield, 1982. From these, *Atlantorchestoidea*, *Orchestoidea*, *Pseudorchestoidea*, and *Talitrus* have a 4-dentate left lacinia mobilis and male and female gnathopods 1 are simple. The remaining six genera are compared with *Bellorchestia* n.gen. in Table 2. *Deshayesorchestia* and *Sardorchestia* were briefly described recently based in a molecular analysis (Ruffo in Tafani *et al.*, 2004). Important characters, such as state of the lacinia mobilis and pleopods, were not properly described, but other significant characters are pointed out in Table 2. Among other characters, the presence of robust setae on epistome and on ventral margins of peduncle of uropods 1–2 distinguish *Bellorchestia* n.gen. from the other related sand-hoppers.

Table 2. Morphological differences among 5-dentate cuspidactylate sand-hopper genera. Abbreviations given on p. 162. Bold states are diagnostic for each genera.

	<i>Americorchestia</i> Bousfield, 1991	<i>Bellorchestia</i> n.gen.	<i>Deshayesorchestia</i> Ruffo, 2004	<i>Megalorchestia</i> Bousfield, 1982	<i>Sardorchestia</i> Ruffo, 2004	<i>Talorchestia</i> s.str. Dana, 1852	<i>Trinorchestia</i> Bousfield, 1982
left lacinia mobilis	5-dentate	5-dentate	?3-dentate	5–6 dentate	?	5-dentate	5-dentate
epistome	without robust setae	with robust setae	without robust setae	without robust setae	without robust setae	without robust setae	without robust setae
Gnt 1 male	parachelate	subchelate	parachelate	simple	parachelate	parachelate	parachelate
Gnt 1 female	simple	parachelate	parachelate	simple	simple	parachelate	parachelate
Gnt 2 female	broadly expanded	linear	weakly expanded	expanded	expanded	expanded	moderately expanded
basis	slightly shorter than peduncle, 7–10 segmented	slightly shorter than peduncle, 7–10 segmented	?	shorter, around half peduncle, 1–3 segmented	?	slightly shorter than peduncle, 7–10 segmented	slightly shorter than peduncle, 7–10 segmented
PL1–3 rami	with several robust setae wider than long	with several robust setae wider than long	with several robust setae as long as wide	with several robust setae wider than long	with several robust setae wider than long	without setae longer than wide	with several robust setae wider than long
U1, outer ramus	North Atlantic	southern Australia	European coast	North Pacific	Mediterranean Sea	Indo-Pacific	northwestern Pacific
telson	and Gulf of Mexico coast		from Baltic and England to the Black Sea; Egypt				
distribution							

***Bellorchestia richardsoni* n.sp.**

Figs 5–8

Type material. HOLOTYPE: male, 22.3 mm, AM P69238 (1 slide, stubs J095–J097, J099, J101–J103). PARATYPES: male, 20.7 mm (habitus) AM P69239 (stub J104); 1 female, 21.8 mm, AM P69240 (1 slide, stubs J6098, J100, SEM micrographs); 18 males and 120 females, AM P69241, supralittoral zone on exposed ocean beach, Point Ricardo, Victoria (37°48.39'S 148°38'E), under dead *Sargassum* on exposed ocean beach, C. Serejo & J.K. Lowry, 8 Oct. 2003, VIC 120.

Type locality. Supra-littoral zone on exposed ocean beach, Point Ricardo, Victoria (37°48.39'S 148°38'E), under dead *Sargassum* on exposed ocean beach.

Etymology. The specific name honours Dr Alastair Richardson (University of Tasmania) who has been contributing to the knowledge of Australian talitrids for many years.

Diagnosis. Male gnathopod 2 palm acute, with 3 protuberances, 2 before dactylar enclosure and 1 defining the posterodistal corner; dactylus shorter than palm, strongly concave medially and not attenuated distally. Peduncle of pleopods 1–3 stout, peduncle 1 about 3× longer than wide, peduncle 2 about 2.5× longer than wide; peduncle 3 about 2.1× longer than wide.

Description

Holotype male, 22.3 mm. Eye medium, $\frac{1}{5}$ – $\frac{1}{3}$ head length. Antenna 1 short, rarely longer than peduncle article 4 of antenna 2. Antenna 2 longer than pereonite 3 and up to half body length; peduncular articles narrow; with sparse, small robust setae; article 5 long, about 2× article 4 length. Epistome with several robust setae. Lower lip distolateral setal tuft absent. Mandible left lacinia mobilis 5-dentate. Maxilliped palp article 2 with distomedial lobe, article 4 present, reduced.

Gnathopod 1 subchelate; posterior margin of propodus with rugose lobe; propodus subrectangular; palm obtuse; dactylus subequal in length to palm, without ventral setal row, simplidactylate. Gnathopod 2 subchelate; basis anteriorly smooth; merus without medial lobe; palm acute, with 3 protuberances, 2 before dactylar enclosure and 1 defining the posterodistal corner; dactylus shorter than palm, strongly concave medially and not attenuated distally. Coxae 2–4 deeper than wide. Pereopods 3–7 cuspidactylate; dactylus without row or patch of dorsal short setae. Pereopod 4 significantly shorter than pereopod 3. Pereopod 4 dactylus thickened and pinched posteriorly, different to pereopod 3 dactylus. Pereopod 5 propodus distinctly longer than carpus. Pereopod 6 sexually dimorphic; shorter than pereopod 7; coxa posterior lobe anterodistal corner rounded, with 5 or more marginal setae, posterior and ventral margins continuously rounded, outer surface with ridge; carpus expanded. Pereopod 7 sexually dimorphic; basis with lateral sulcus

slightly pronounced, posterodistal lobe present; distal articles expanded; carpus subrectangular. Coxal gills convoluted, processiferous or lobate. Pereopods 3–5 gills smaller than gills 2 and 6.

Pleopods 1–3 well developed, rami shorter than peduncle; peduncle stout with several marginal robust setae, peduncle 1 about 3× longer than wide, peduncle 2 about 2.5× longer than wide; peduncle 3 about 2.1× longer than wide, both rami shorter than peduncle. Epimeron 2 subequal in length to epimeron 3. Epimeron 3 posterior margin smooth, with setae, posteroventral corner subquadrate, ventral margin without robust setae. Uropod 1 peduncle with 20–23 robust setae in two rows and a row of ventral setae; distolateral robust seta absent; inner ramus subequal in length to outer ramus, with 8–10 robust setae on each margin and 6–8 smaller setae on facial surface; outer ramus with 9 robust setae on outer margin; rami with ventral setae. Uropod 2 peduncle with 24 robust setae in two rows and a row of ventral setae; inner ramus subequal in length to outer ramus, with 7–8 robust setae on each margin and 6–7 smaller setae on facial surface; outer ramus with 5 robust setae on outer margin. Uropod 3 peduncle with 11 robust setae; ramus subequal in length to peduncle; oval to spatula-shape, broad distally; ramus with 24 marginal setae, and 4–5 apical setae. Telson broader than long; apically incised; dorsal midline vestigial or absent; with marginal and apical robust setae; around 19 setae per lobe.

Female (sexually dimorphic characters), 21.8 mm. Gnathopod 1 parachelate; posterior margin of merus, carpus and propodus without rugose lobe; palm minute, transverse and with a tuft of robust setae on the palmar angle; dactylus longer than palm. Gnathopod 2 mitten-shaped; basis narrow and long; about 2.8× longer than wide, posterior margin of propodus with rugose lobe; palm obtuse, smooth. Pereopod 6 carpus slender. Pereopod 7 distal articles slender. Oostegites longer than wide; setae with simple straight tips. Oostegites 2–4 moderately setose (around 24 setae).

Habitat. Exposed ocean beaches.

Remarks. *Bellorchestia richardsoni* n.sp. is similar to *Bellorchestia pravidactyla* described from Tasmania by Haswell (1880) in general aspects of the body, such as peduncular article 5 of antenna 2 which is long, about 2× article 4 length, and male gnathopod 1, which is subchelate with a transverse palm. Some differences between these species are the propodus of male gnathopod 1, which has a well-developed rugose lobe (versus small lobe, nearly undistinguished), male gnathopod 2 with 3 protuberances, 2 before dactylar enclosure and 1 defining the posterodistal corner (versus no protuberances) and female gnathopod 1 is parachelate instead of simple. Considering that *B. pravidactyla* was only briefly described and that the types are lost (Lowry & Stoddart, 2003), we prefer to consider the Victorian species as new. Designation of a neotype based on topotypic material from Tasmania would better elucidate the status of *B. pravidactyla*.

Distribution. Victoria: Point Ricardo.

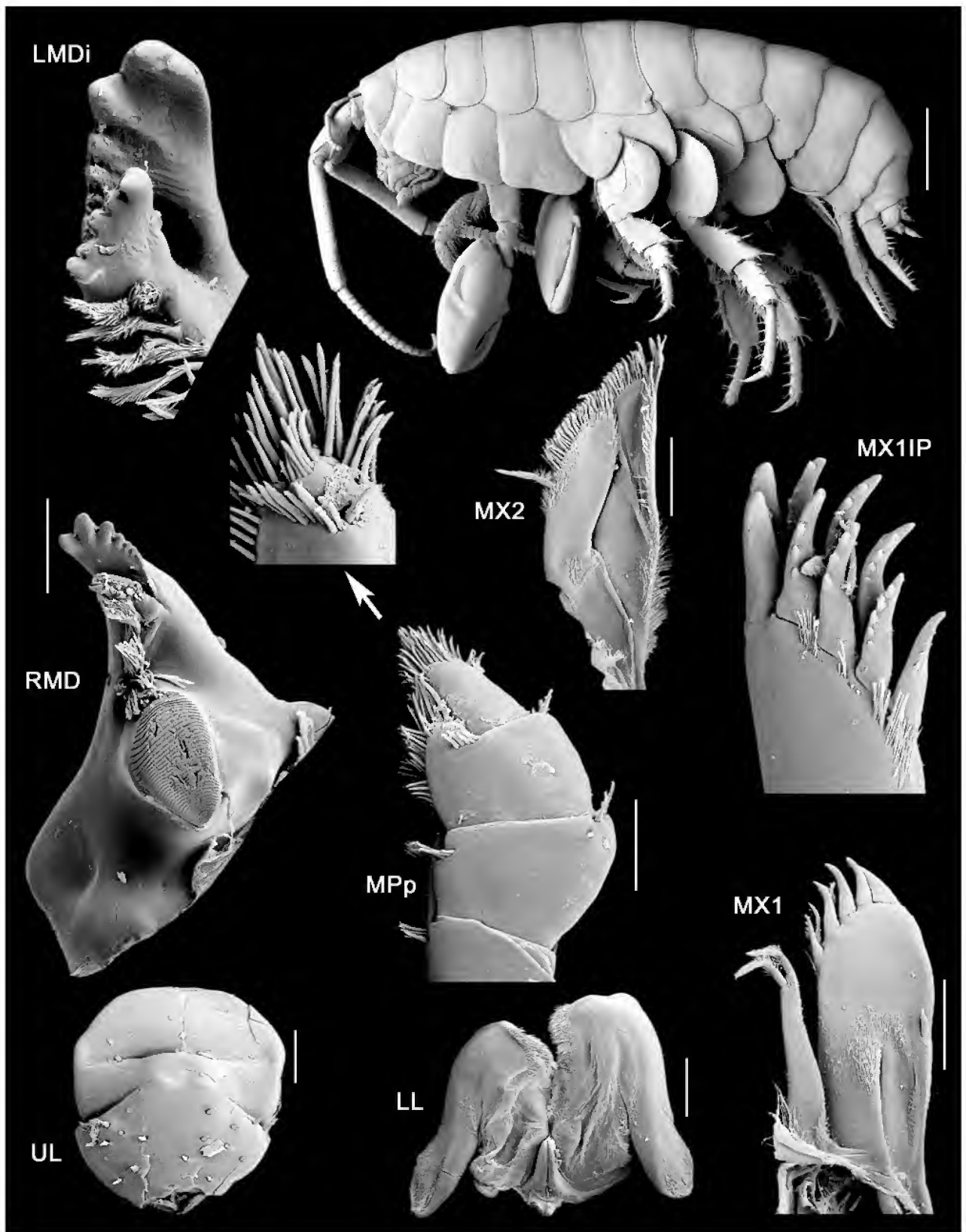


Fig. 5. *Bellorchestia richardsoni* n.sp., paratype male, 20.7 mm, habitus, AM P69239; holotype male, 22.3 mm, other parts, AM P69238, Point Ricardo, Victoria. Scale for habitus: 1 mm, remainder: 0.2 mm.

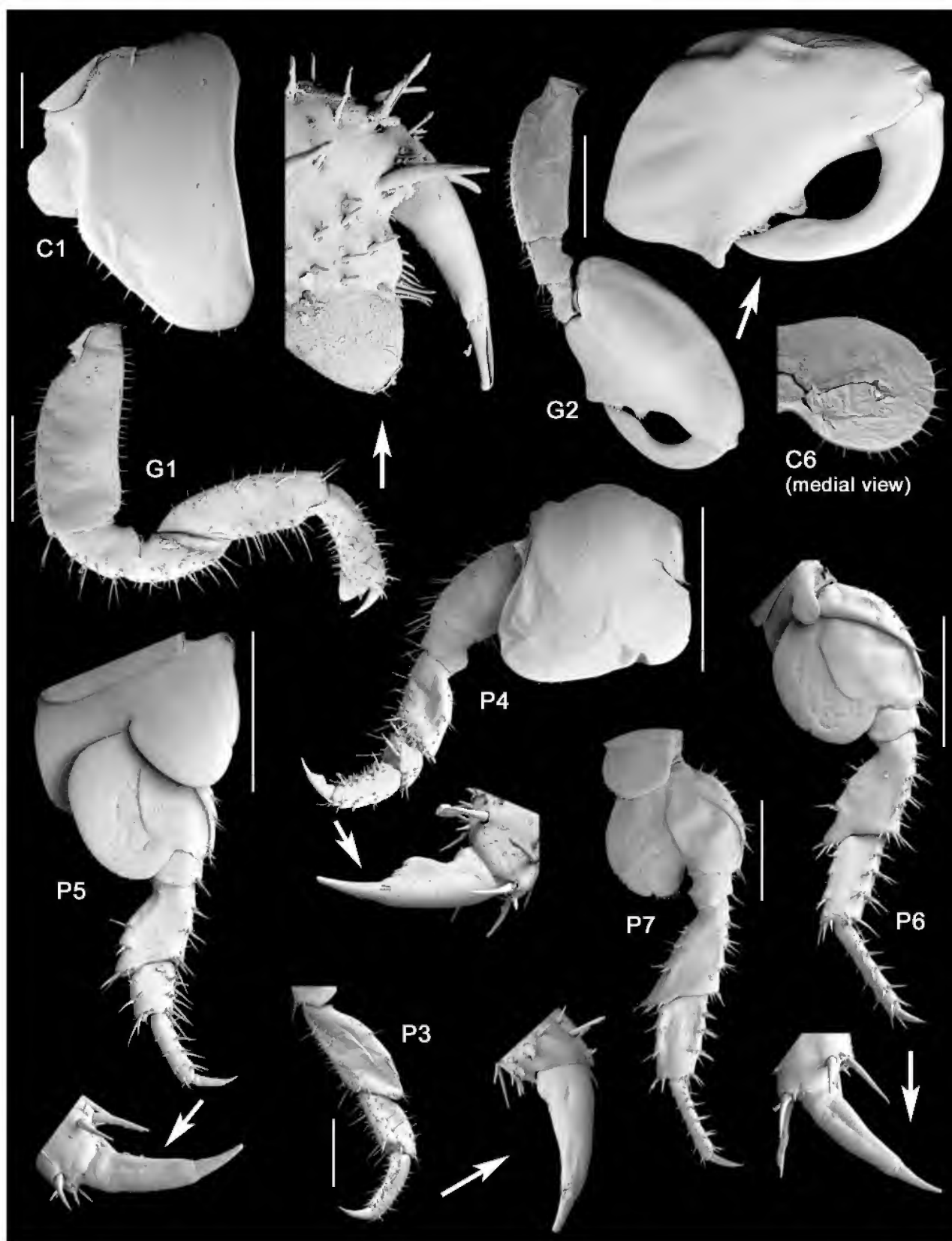


Fig. 6. *Bellorchestia richardsoni* n.sp., holotype male, 22.3 mm, AM P60238, Point Ricardo, Victoria. Scales for G1–2: 1 mm; C1: 0.5 mm; remainder: 2 mm.

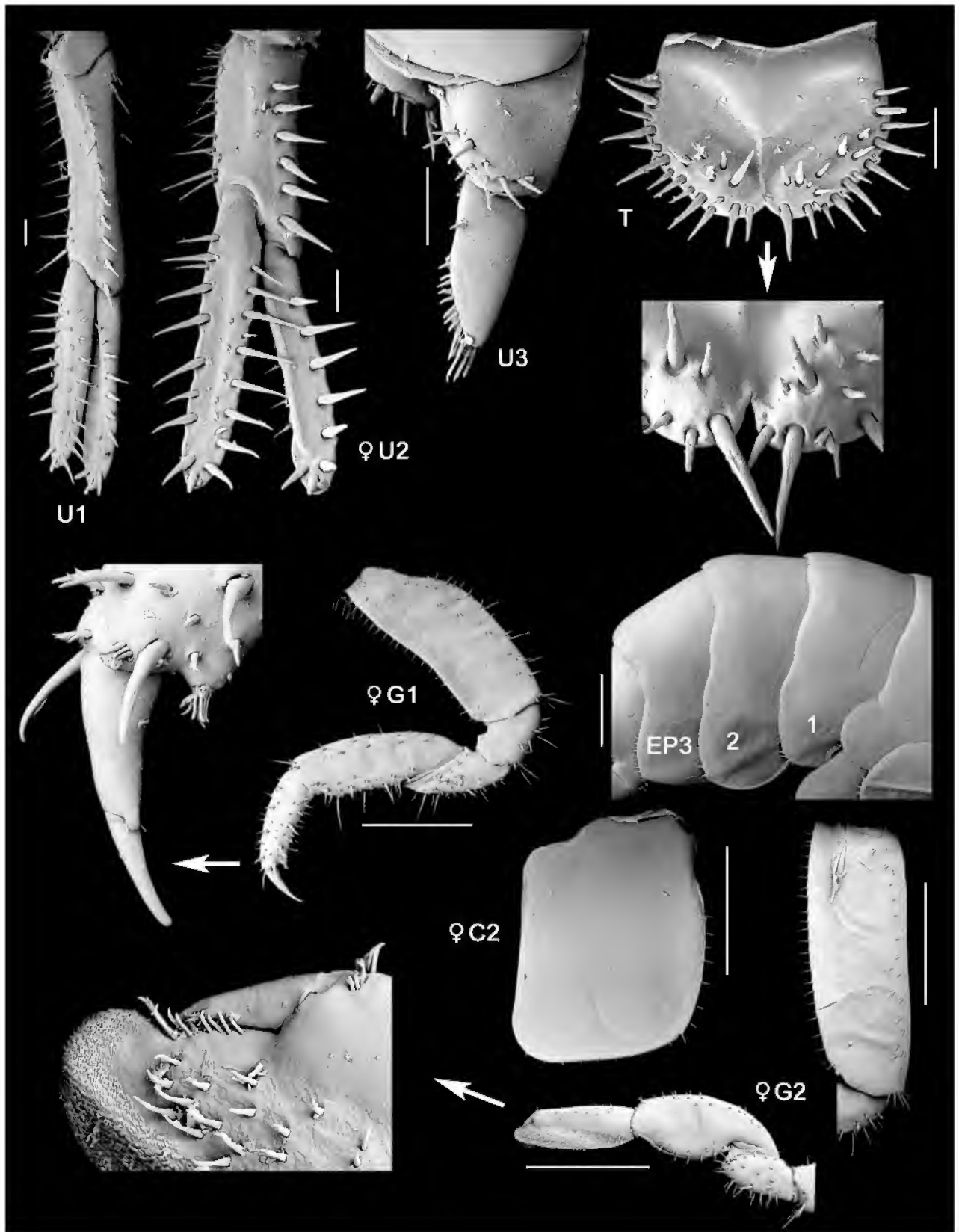


Fig. 7. *Bellorchestia richardsoni* n.sp., holotype male, 20.3 mm, T, EP1–3, AM P60238; paratype male, 22.7 mm, U1–3, AM P69239; paratype female, 21.8 mm, G1–2, AM P69240, Point Ricardo, Victoria. Scales for EP1–3, G1–2: 1 mm; remainder: 0.2 mm.

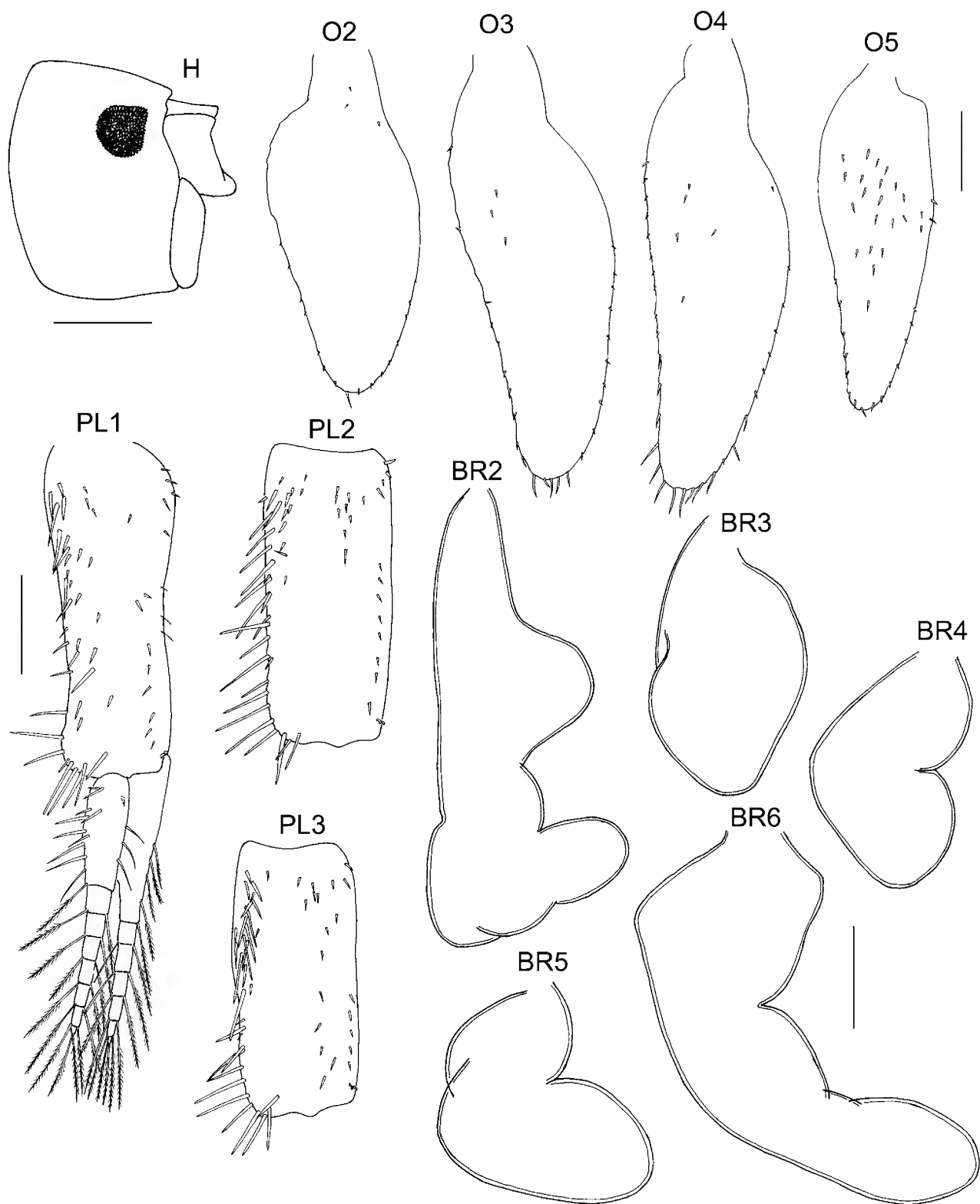


Fig. 8. *Bellorchestia richardsoni* n.sp., paratype female, 21.8 mm, O2–5, AM P69240; paratype male, 22.7 mm, PL1–3 and BR2–6, AM P69239. Scales represent 0.5 mm.

***Notorchestia* n.gen.**

Orchestia J.L. Barnard, 1969: 470 (partim).
Talorchestia Dana, 1852: 851.—Stebbing, 1906: 543
 (partim).—Stephensen, 1948: 7 (partim).—J.L. Barnard,
 1969: 472 (partim.).

Type species. *Notorchestia lobata* n.sp.

Etymology. *Noto* means southern and refers to the distribution of the genus, attached to the stem *Orchestia* from the Greek *orchestes* = dancer.

Diagnosis. Antenna 2 not geniculate and not sexually dimorphic. Mandible left lacinia mobilis 4 or 5 dentate. Maxillipedal palp dactylus present, reduced. Gnathopod 2 subchelate; basis slightly expanded; propodus palm posterodistal corner with or without protuberance. Pereopods 3–7 cuspidactylate, dactylus with row or patch of dorsal setae. Pereopod 4 carpus similar in length to pereopod 3 carpus. Pereopod 6 not sexually dimorphic. Pereopod 7 sexually dimorphic or not; basis lateral sulcus present or absent, if present very pronounced. Gills lobate and/or convoluted; gills 3–5 smaller than gills 2 and 6. Oostegites 2–5 setae with simple and multi-furcate tips. Pleopods all well developed. Uropods 1–2 outer rami with marginal robust setae. Telson cleft, longer than broad with 3–5 robust setae per lobe.

Species composition. *Notorchestia* contains 4 species: *N. australis* (Fearn-Wannan, 1968); *N. lobata* n.sp.; *N. naturaliste* n.sp. and *N. novaehollandiae* (Stebbing, 1899).

Remarks. The weakness of the definition of *Orchestia* and *Talorchestia* based on the female gnathopod 2 chelation is herein reconfirmed. A restricted definition of *Talorchestia* (*sensu stricto*) was proposed by Morino and Miyamoto (1988) and Miyamoto and Morino (1999), but this is incomplete because it leaves a large number of species with no generic name. A revision of the whole complex is still needed. Some species within *Notorchestia* were part of the *Talorchestia* (*sensu lato*) group, a wide complex currently including about 35 species. We move eight species to *Bellorchestia* and two to *Notorchestia*, reducing the number of unplaced species to 25.

Notorchestia n.gen. is endemic to Australia, and its species show new characters for the Talitridae in general, such as the dactylus of pereopod 3–7 with a dorsal row of setae (Figs 14, 18), the multi-furcate tip setae on oostegites 2–5 (Fig. 12, 16, 20) and a clearly cleft telson (Fig. 11, 15, 19). *Notorchestia* is a member of the 4-dentate left lacinia mobilis group. The one exception is found in *N. australis*, which has a 4 or 5-dentate left lacinia. Not all of the diagnostic characters were observed in *N. novaehollandiae*, but the lateral sulcus on the basis of pereopod 7 and cleft telson strongly suggests that this species is part of this genus.

***Notorchestia australis* (Fearn-Wannan, 1968)**

Figs 7–9

Lowry & Stoddart, 2003: 272.

Type material. HOLOTYPE: male, 15 mm, NMV J160, Hastings, Western Port, Victoria, Australia. PARATYPES: 1 female, 11.5 mm, NMV J161, same data as holotype.

Material examined. *New South Wales*: 5 females, AM P 36217, Fisheries Creek, Twofold Bay, on saltmarsh, J.T. van der Velde & S.J. Keable, 19 Sep. 1984; 1 male, AM P 36037, Curralo Lagoon, Twofold Bay, on saltmarsh, S.J. Keable & M.L. Reid, 27 June 1985. *Victoria*: 1 female, 12 mm, NMV J42333, Apollo Bay, Victoria, Australia; 5 males and 9 females, AM P68961, Old Port, Port Albert (38°40.03'S 146°40.13'E), narrow beach with a lot of dead *Zostera* and marsh directly behind, specimens living among *Zostera* at top of beach and among roots of marsh plants, C. Serejo & J.K. Lowry, 10 Oct. 2003, VIC 125; 1 male and 2 females, AM P68962, among roots of marsh plants under bridge, Painkalac Creek (38°28.01'S 144°5.54'E), C. Serejo & J.K. Lowry, 11 Oct. 2003, VIC 127; 1 female, AM P68963, Peterborough Beach where the river comes into the sea, Peterborough (38°36.6'S 142°52.67'E), freshwater creek with stony bottom, specimens living under stones (freshwater), C. Serejo & J.K. Lowry, 12 Oct. 2003, VIC 133. *South Australia*: 1 female 11.1 mm, AM P69009 (2 slides, stub J064, SEM micrographs); 1 male, 15.4 mm, AM P69014 (slide), + 236 specimens, AM P68964, beach on west side of breakwater, Port Macdonnell, South Australia (38°3.56'S 140°41.63'E), broad flat beach thickly covered in dead algae and seagrass 3–4 m from water line, C. Serejo & J.K. Lowry, 14 Oct. 2003, SA 137; 2 males, 16.1 mm, AM P69007 (slide, stubs J063, J065–J070), male, 13.3 mm, AM P69008 (left mandible); 15.3 mm (habitus), AM P69006 (stub J083, SEM micrographs) + 116 specimens, AM P68965, beach on west side of breakwater, Port Macdonnell, (38°3.56'S 140°41.63'E), broad flat beach thickly covered in dead algae and seagrass 24 m from water line, C. Serejo & J.K. Lowry, 14 Oct. 2003, SA 138; 1 male and 7 females, AM P68966, *Melaluca* marsh, Lake Baddy, (37°10.45'S 139°47.41'E), marshland with *Juncus* and tall marsh grass, C. Serejo & J.K. Lowry, 14 Oct. 2003, SA 141; 1 male, AM P68967, *Melaluca* marsh beside main fishing port, Robe, (37°9.05'S 139°44.98'E), stones on mud in scraggly *Melaluca* marsh, C. Serejo & J.K. Lowry, 14 Oct. 2003, SA 143; 60 specimens, AM P68968, Goolwa marsh, Coorong National Park, (35°31.82'S 138°48.51'E), estuarine area with rocks and dry vegetation near water, C. Serejo, J.K. Lowry & J. Bradbury, 15 Oct. 2003, SA 145; 7 males and 3 females, AM P68969, Victor Harbour, Encounter Bay, (35°33.07'S 138°37.44'E), sheltered harbour beach, C. Serejo, J.K. Lowry & J. Bradbury, 15 Oct. 2003, SA 146; 84 specimens, AM P68970, beach in Yankalilla Bay, Fleurieu Peninsula (35°28.73'S 138°46.75'E), sandy, rocky beach, C. Serejo, J.K. Lowry & J. Bradbury, 15 Oct. 2003, SA 148; 14 males and 22 females, AM P68971, Lucky Bay, Spencer Gulf, Eyre Peninsula (33°42.48'S 137°2.59'E), broad, flat, sheltered, white sand beach rising in the supra-littoral, C. Serejo & J.K. Lowry, 17 Oct. 2003, SA 151; 4 males and 7 females, AM P68972, small mangrove just north of town, Ceduna, Eyre Peninsula (32°8.87'S 133°40.24'E), small mangrove area with stony substrate, C. Serejo & J.K. Lowry, 19 Oct. 2003, SA 156; 400 specimens, AM P68973, Fowlers Beach, Fowlers Bay, Eyre Peninsula, (31°59.24'S 132°26.26'E), broad beach covered to a depth of at least a meter with dead seaweed, C. Serejo & J.K. Lowry, 19 Oct. 2003, SA 157; 2 males, 1 female, AM P68974, Sleaford Mere, Eyre Peninsula (34°48'S 135°44'E), on stromatolite-like structures on the bottom of salt lake [talitrids living in cracks among calcite structures on the bottom of the lake, so the talitrids were completely submersed in the water—salinity about the same as seawater], B. Timms, 20 Jul 2003, SA 158; 4 males, AM P68975, Sleaford Mere, Eyre Peninsula (34°48'S 135°44'E), on stromatolite-like structures on the bottom of salt lake [talitrids living in cracks among calcite structures on the bottom of the lake, so the talitrids were completely submersed in the water—salinity about the same as seawater], B. Timms, 27 Oct. 2003, SA 159.

Type locality: Hastings, Western Port, Victoria, Australia. On rocky beach found in the damp sand under stones in the inter-tidal zone.

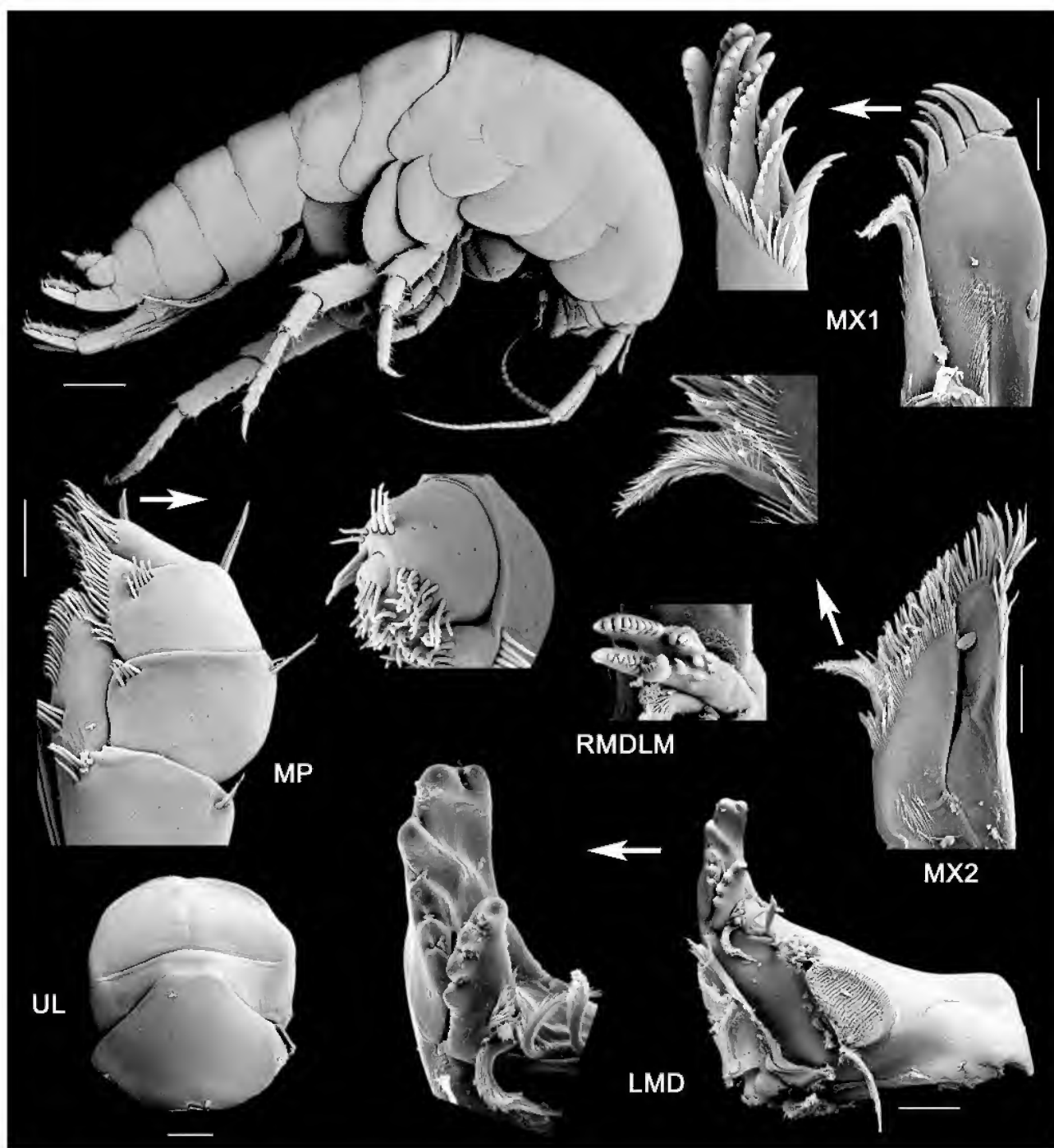


Fig. 9. *Notorchestia australis* (Fearn-Wannan, 1968), male, 15.3 mm, habitus, AM P69006; male, 16.1 mm, other parts, AM P69007, Port Macdonnell, South Australia. Scale for habitus: 1 mm; remainder: 0.1 mm.

Diagnosis. Mandible left lacinia mobilis 4–5 dentate. Male gnathopod 2, palm smooth, with row of robust setae; dactylus slightly attenuated distally. Coxa 6, posterior lobe posteroventral margins with 1–3 robust setae. Pereopod 7 basis in male tapering distally, lateral sulcus absent, posterodistal corner with 90° angle, lobe absent.

Description

Male, 13.3–16.1 mm. Eye medium, $\frac{1}{5}$ – $\frac{1}{3}$ head length. Antenna 1 short, rarely longer than peduncular article 4 of antenna 2. Antenna 2 shorter than head and first 3 pereonites;

peduncular articles narrow; with sparse, small robust setae. Epistome of upper lip without robust setae. Lower lip, dislateral setal tuft absent. Mandible left lacinia mobilis 4–5 dentate. Maxilliped palp article 2 with mediolateral lobe, article 4 present, reduced.

Gnathopod 1 sexually dimorphic; subchelate; posterior margin of merus, carpus and propodus with rugose lobe; propodus subtriangular; palm transverse; dactylus shorter than palm, simplidactylate. Gnathopod 2 sexually dimorphic; subchelate; palm acute, smooth, with row of robust setae, posterodistal corner with groove; dactylus longer than palm, slightly attenuated distally. Coxae 2–4 as wide as deep.

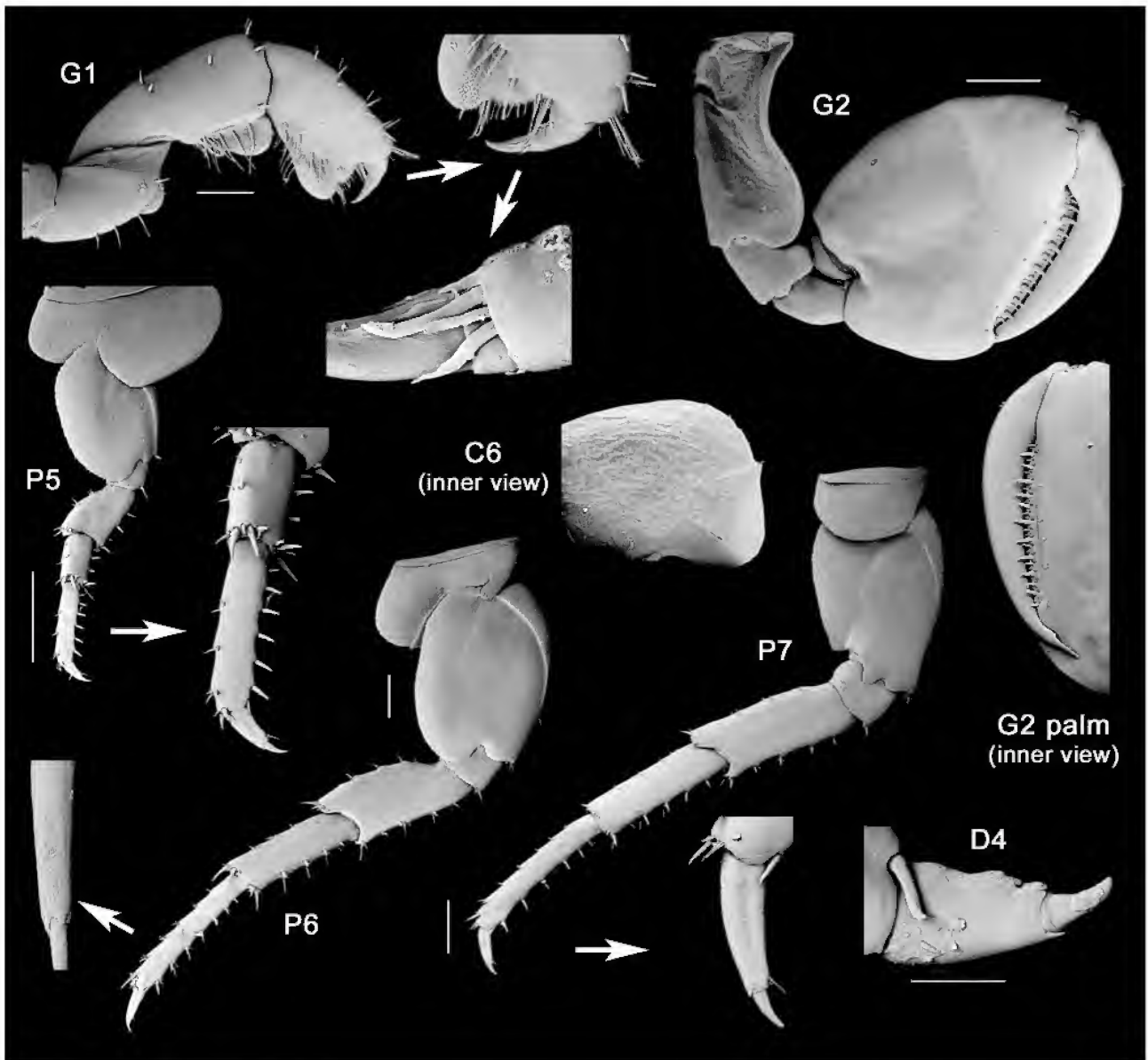


Fig. 10. *Notorchestia australis* (Fearn-Wannan, 1968), male, 16.1 mm, AM P69007, Port Macdonnell, South Australia. Scales for G1: 0.2 mm; D4: 0.1 mm; remainder: 0.5 mm.

Pereopods 3–7 cuspidactylate; dactylus with row or patch of dorsal short setae. Pereopod 4 subequal or slightly shorter than pereopod 3. Pereopod 4 dactylus thickened and pinched posteriorly, different to pereopod 3 dactylus. Pereopod 5 propodus distinctly longer than carpus. Pereopod 6 not sexually dimorphic; shorter than pereopod 7; coxa posterior lobe anterodistal corner rounded, posteroventral margins with 1–3 marginal setae, posterior margin perpendicular to ventral margin, outer surface with ridge. Pereopod 7 basis sexually dimorphic; basis without lateral sulcus, posterior margin tapering distally, posterodistal corner forming a 90° angle, lobe absent; distal articles slender. Coxal gills simple or slightly lobate. Pereopods 3–5 gills smaller than gills 2 and 6.

Pleopods 1–3 well developed; biramous; inner ramus slightly longer than outer ramus. Pleopod 1 peduncle with 2–3 setae on outer margin and 1 medio-facial seta. Pleopod 2 with 2 setae on outer margin and 4–5 medio-facial setae.

Pleopod 3 peduncle outer margin apparently without setae and 8–10 medio-facial setae. Epimera 1–3 posteroventral corner slightly produced into a small subacute spine. Epimeron 3 posterior margin minutely serrate, with setae, ventral margin without setae. Uropod 1, peduncle with 12 robust setae in two rows; distolateral robust seta absent; inner ramus subequal in length to outer ramus; inner ramus with 5 marginal robust setae; outer ramus with 3 marginal robust setae. Uropod 2 peduncle with 7 robust setae in two rows; inner ramus subequal in length to outer ramus; inner ramus with 4 marginal robust setae, 3 on outer margin and 1 on inner margin; outer ramus with 1 marginal robust seta. Uropod 3 peduncle with 3–4 robust setae; ramus subequal in length to peduncle; triangular, narrowing distally; ramus with a sequence of 7–9 marginal slender setae and 5–6 apical setae. Telson longer than broad; incised to half the length; each lobe with 3 lateral robust setae and 1–2 smaller distal robust setae.

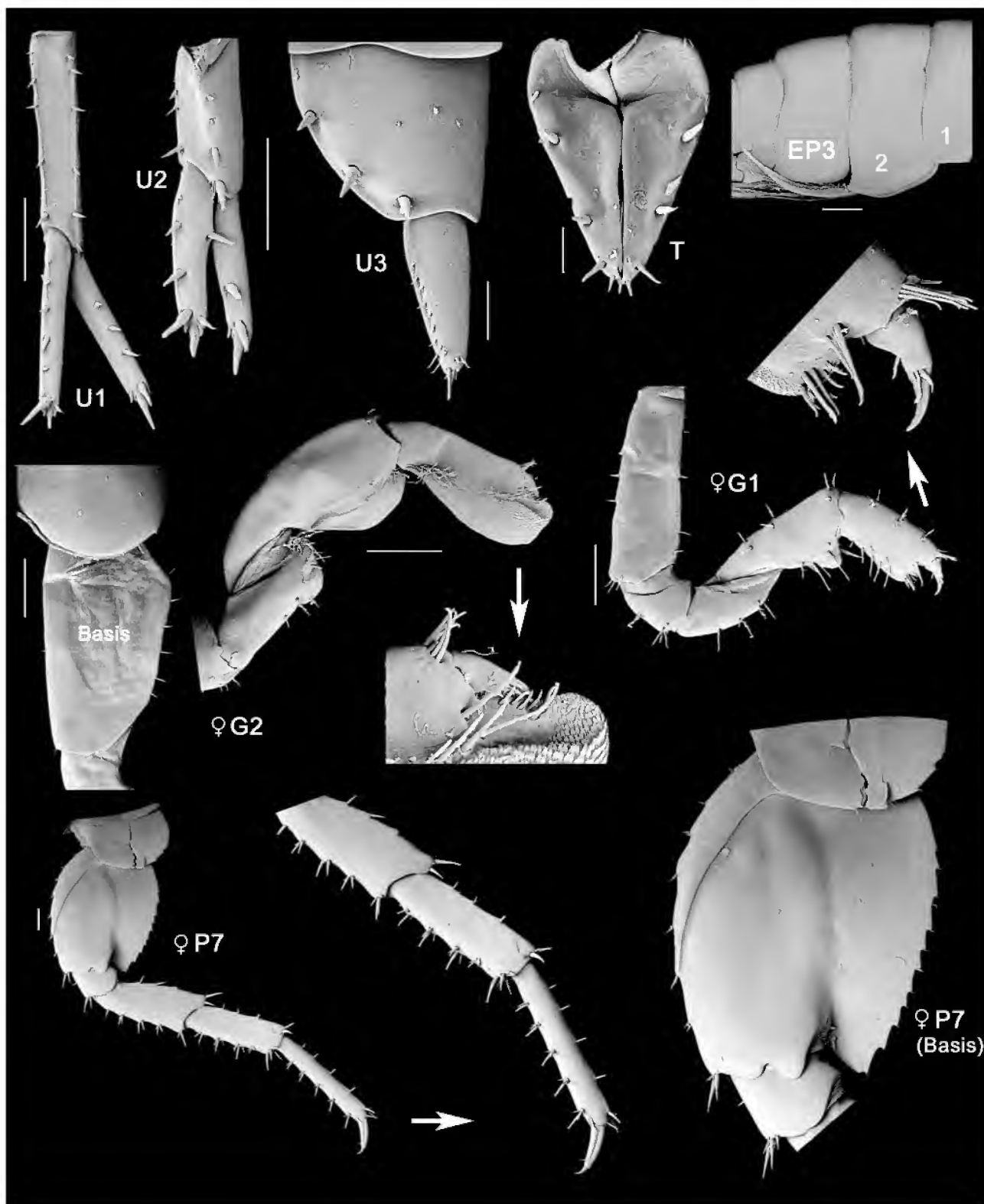


Fig. 11. *Notorchestia australis* (Fearn-Wannan, 1968), male, 16.1 mm, EP1–3, U1–3, T, AM P69007; female 11.1 mm, G1–2, P7, AM P69009, Port Macdonnell, South Australia. Scales for U3 and T: 0.1 mm; G1–2 and P7: 0.2 mm; EP1–3 and U1–2: 0.5 mm.

Female (sexually dimorphic characters), 15.1 mm. Gnathopod 1 subchelate; posterior margin of carpus and propodus with rugose lobe; propodus subrectangular; dactylus subequal in length to palm. Gnathopod 2 mitten-shaped; basis slightly expanded, about 1.8× longer than wide; carpus well developed, not enclosed by merus and propodus; posterior margin of

merus, carpus and propodus with rugose lobe; palm obtuse; dactylus shorter than palm. Pereopod 7 basis not tapering distally, posterodistal corner slightly produced into a small pointed lobe. Uropod 3 ramus with 6 marginal setae. Oostegites longer than wide; setae with simple and multi-furcate tips. Oostegites 2–4 moderately setose (around 24 setae).

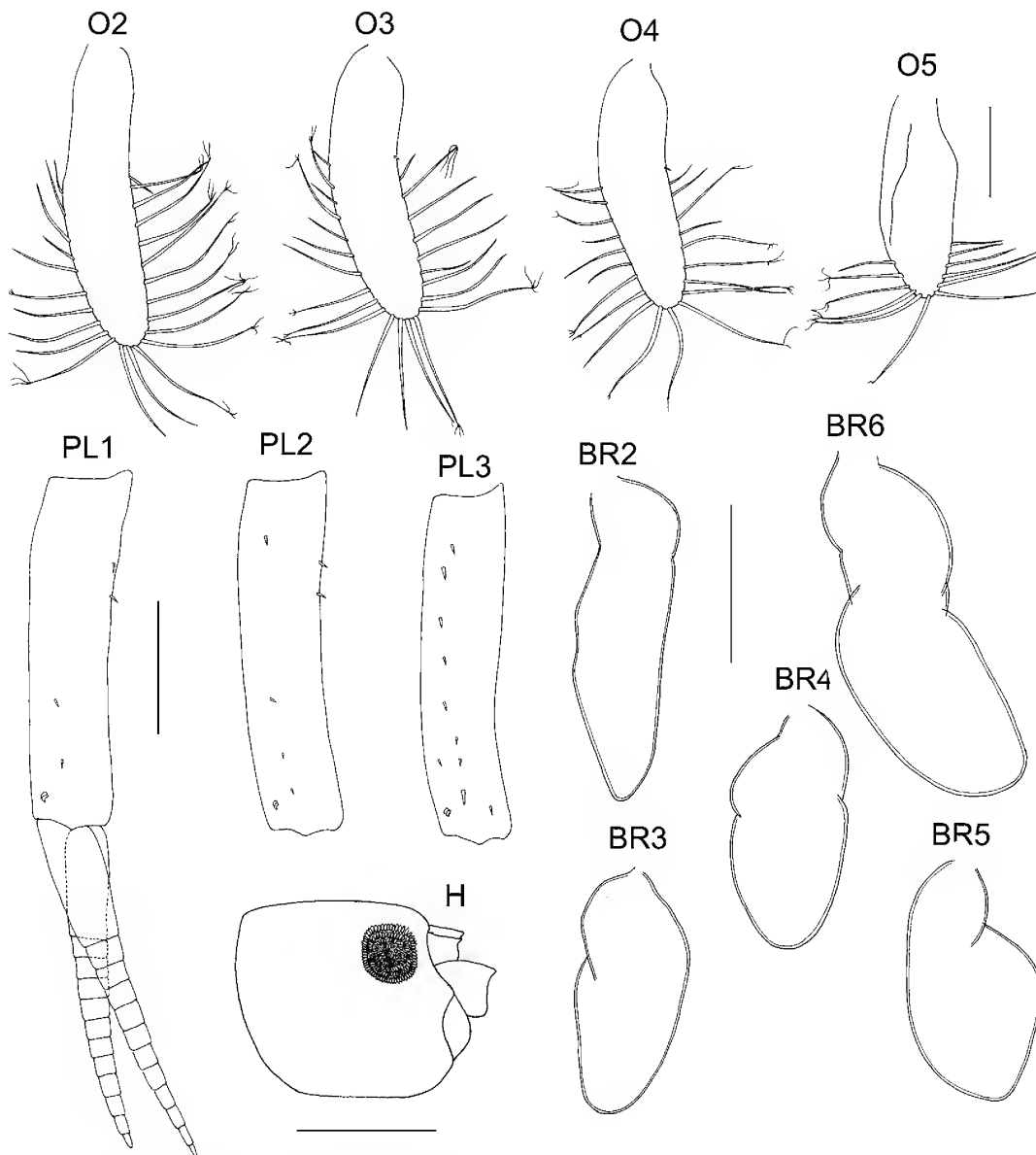


Fig. 12. *Notorchestia australis* (Fearn-Wannan, 1968), female, 11.1 mm, O2–5 and BR2–6, AM P69009; male, 16.1 mm, H and PL1–3, AM P69007. Scales for H: 1 mm; remainder: 0.5 mm.

Habitat. This species colonized a variety of habitats ranging from the supra-littoral of protected beaches to estuarine areas as salt-marshes.

Remarks. The type material of *N. australis* (Fearn-Wannan, 1968) was re-examined and compared carefully with material collected in this study. All the diagnostic characters described in Fearn-Wannan (1968) as well as other characters herein proposed were found in the holotype and the examined material. One exception was the number of teeth on the left lacinia mobilis. The holotype examined has a 5-dentate lacinia although the fifth tooth is very small and the paratypes have a well defined 5-dentate lacinia. On the other hand, all the specimens dissected in the material examined (8) have a 4-dentate left lacinia mobilis. This variation leads to confusion as Bousfield (1982, 1984) used the number of the left lacinia to define genera within the Talitridae. However, variation in the number of teeth on the left lacinia (4 to 5 teeth) of

Traskorchestia species was also noted (Bousfield, 1982). Thus, we decided to maintain this character as an intra-specific variation and consider the ANTS material as *N. australis*.

Notorchestia australis was commonly found on the South Australia samples occurring in 17 of the 23 stations. It occurs sympatrically with *Notorchestia lobata* n.sp. in two stations (SA 146 and SA 148).

Distribution. *New South Wales:* Twofold Bay. *Victoria:* Old Port, Port Albert; Painkalac Creek; Peterborough Beach (ANTS material). Lake King; Port Philip Bay and Western Port Bay (Fearn-Wannan, 1968). *South Australia:* Port Macdonnell; Lake Baddy; Robe; Goolwa marsh, Coorong National Park; Victor Harbour, Encounter Bay; Fleurieu Peninsula; Yankalilla Bay, Eyre Peninsula; Spencer Gulf, Eyre Peninsula; Ceduna, Eyre Peninsula; Fowlers Beach, Fowlers Bay, Eyre Peninsula; Sleaford Mere, Eyre Peninsula.

Notorchestia lobata n.sp.

Figs 13–16

Type material. HOLOTYPE: male, 10.8 mm, AM P69051 (slide, stubs J085–J087, J091–J094). PARATYPES: male, 10.8 mm, AM P69055 (stub J084); 1 female, 11 mm, AM P69052 (slide, stubs J088, J090 [part, G1–2]); 2 juvenile males, 10 mm and 7.9 mm, AM P69053 (mixed on stub J089, SEM micrographs); male, 12.5 mm, AM P69054; female, 9.1 mm, AM P69056 (stub J090 [part, G1]); 51 specimens, AM 69057, all from Goolwa Beach, Encounter Bay, South Australia (35°31.47'S 138°48.51'E), wide beach with a lot of dead seagrass and seaweed over hard grey sand, C. Serejo, J.K. Lowry & J. Bradbury, 15 Oct. 2003, SA 144.

Type locality. Goolwa Beach, Encounter Bay (35°31.47'S 138°48.51'E), SA.

Additional material examined. *Victoria*: 42 specimens, AM P69015, supra-littoral zone on exposed ocean beach, Point Ricardo (37°48.39'S 148°38'E), beach-hoppers under dead *Sargassum* on exposed ocean beach, C. Serejo & J.K. Lowry, 8 Oct. 2003, VIC 120; 20 specimens, AM P69016, Woodside Beach (between Sale and Yarram) (38°33.29'S 146°58.47'E), beach-hoppers under dead *Sargassum*, exposed windswept beach with little seaweed, C. Serejo & J.K. Lowry, 9 Oct. 2003, VIC 123; AM P69017, 85 specimens, Lorne Beach near mouth of Erskine River, Lorne (38°32.1'S 143°58.59'E), broad ocean beach with dead seaweed in supra-littoral, C. Serejo & J.K. Lowry, 12 Oct. 2003, VIC 128; 72 specimens, AM P69018, Ocean beach, Separation Creek (38°37.96'S 143°53.78'E), ocean beach with rock reefs immediately offshore, C. Serejo & J.K. Lowry, 12 Oct. 2003, VIC 130; 22 specimens, AM P69019, Peterborough Beach, Peterborough (38°36.6'S 142°52.67'E), ocean beach with beach-hoppers under seaweed, C. Serejo & J.K. Lowry, 12 Oct. 2003, VIC 132; 130 specimens, AM P69020, Sandy beach, The Craigs (38°22.36'S 142°6.59'E), narrow sandy beach with vertical cliffs directly behind and rock platform in front with *Ulva*, *Sargassum* and *Cystophora*, C. Serejo & J.K. Lowry, 13 Oct. 2003, VIC 134; 76 specimens, AM P69021, Shelly Beach, Bridgewater Bay (38°21.65'S 141°26.14'E), Sandy beach with accumulations of small gastropod shells, C. Serejo & J.K. Lowry, 13 Oct. 2003, VIC 136; 47 specimens, AM P69033, Sandy Point (38°50'S 146°08'E), under dry kelp, A. Murray, 29 Dec. 2003, VIC 137.

South Australia: 12 specimens, AM P69022, Beachport Beach, Rivoli Bay (37°29.01'S 140°3.39'E), sheltered beach, dunes behind beach, C. Serejo & J.K. Lowry, 14 Oct. 2003, SA 140; 35 specimens, AM P69023, Victor Harbour, Encounter Bay (35°33.07'S 138°37.44'E), sheltered harbour beach, C. Serejo, J.K. Lowry & J. Bradbury, 15 Oct. 2003, SA 146; 89 specimens, AM P69024, beach in Yankalilla Bay, Fleurieu Peninsula (35°28.73'S 138°46.75'E), sandy, rocky beach, C. Serejo, J.K. Lowry & J. Bradbury, 15 Oct. 2003, SA 148.

Western Australia: 2 males and 3 females, AM P69025, Ocean beach, Eucla (31°43.29'S 129°53.31'E), broad white sand beach with clumps of seagrass and seaweed, with dunes behind, C. Serejo & J.K. Lowry, 20 Oct. 2003, WA 753; 40 specimens, AM P69026, Fourth Beach, Esperance (33°53.29'S 121°50.7'E), exposed white sand beach with small amounts of seaweed, C. Serejo & J.K. Lowry, 21 Oct. 2003, WA 754; 10 males and 19 females, AM P69027, West Beach, Hopetoun (33°52'S 121°52'E), on seaweed at enclosed sheltered white sand beach, C. Serejo & J.K. Lowry, 21 Oct. 2003, WA 755; 2 males and 3 females, AM P69028, Slippery Rock, Cape Leuwin (34°21.44'S 115°7.64'E), mixed and dead seaweed lodged between large boulders at the end of a steeply sloping white sand beach, C. Serejo & J.K. Lowry, 23 Oct. 2003, WA 759; 48 specimens, AM P69029, Binningup Beach, Bunbury (33°9.02'S 115°41.08'E), exposed sandy beach, C. Serejo & J.K. Lowry, 24 Oct. 2003, WA 761; 33 specimens, AM P69030, South Cottesloe Beach, Perth (32°0.28'S 115°45.03'E), sandy beach with a lot of dead seagrasses and seaweed, C. Serejo, J.K. Lowry & D. Jones, 26 Oct. 2003, WA 762; 140 specimens, AM P69031, Jurien Beach, Jurien (30°18.38'S 115°1.99'E), sandy beach with a lot of dead seagrasses and seaweed, C. Serejo & J.K. Lowry, 28 Oct. 2003, WA 765; 1 female, AM P69032, Disappointment Loop, Henri Freycinet Harbour, Shark Bay (26°40.21'S 113°40.31'E), low rock platform moving into clayey mudflats with small banks covered in holes with small smooth clay channels between, C. Serejo & J.K. Lowry, 4 Nov. 2003, WA 775.

Etymology. This species is named for the lobate structure on the posterodistal margin of the merus of gnathopod 2.

Diagnosis. Mandible left lacinia mobilis 4-dentate. Dactylus of gnathopod 1 with row of ventral short setae. Gnathopod 2 male, propodus subquadrate; palm slightly acute to transverse, with large midpalmar concavity. Female and male juvenile gnathopod 2 merus with distally rounded posterodistal medial lobe. Coxa 6 posterior lobe posteroventral margins with 13–15 robust setae. Basis of pereopod 7 with lateral sulcus. Telson cleft to half length.

Description

Holotype male, 10.8 mm. Eye medium, $\frac{1}{5}$ – $\frac{1}{3}$ head length. Antenna 1 short, rarely longer than peduncle article 4 of antenna 2. Antenna 2 shorter than head and first 3 pereonites; peduncular articles narrow; with many robust setae; article 5 longer than article 4. Epistome of upper lip without robust setae. Lower lip distolateral setal tuft absent. Mandible left lacinia mobilis 4-dentate. Maxilliped palp article 2 with distomedial lobe, article 4 present, reduced.

Gnathopod 1 sexually dimorphic; subchelate; posterior margin of carpus and propodus with rugose lobe; propodus sub-triangular; palm transverse; dactylus subequal in length to palm, with ventral setal row, simplidactylate. Gnathopod 2 sexually dimorphic; sub-chelate; basis anteriorly smooth; merus without posterodistal medial lobe; propodus sub-quadrate; palm slightly acute to transverse, with large midpalmar concavity; dactylus longer than palm, concave and not attenuated distally. Coxae 2–4 deeper than wide. Pereopods 3–7 cuspidactylate; dactylus with row or patch of dorsal short setae. Pereopod 4 significantly shorter than pereopod 3. Pereopod 4 dactylus thickened and pinched posteriorly, different to pereopod 3 dactylus. Pereopod 5 propodus distinctly longer than carpus. Pereopod 6 not sexually dimorphic; shorter than pereopod 7; coxa posterior lobe anterodistal corner rounded, posteroventral margins with 13–15 robust setae, posterior margin perpendicular to ventral margin, outer surface with ridge; carpus slender. Pereopod 7 sexually dimorphic; basis with lateral sulcus well developed, posterodistal lobe present; distal articles slender. Coxal gills convoluted, processiferous or simple. Pereopods 3–5 gills smaller than gills 2 and 6.

Pleopods 1–3 well developed, biramous. Peduncles of pleopods 1–2 with 10 robust setae, 8 on outer margin and 1–2 facial. Peduncle of pleopod 3 with 14 setae, 7 on outer margin and 7 facial. Epimeron 2 longer than epimeron 3. Epimeron 3 posterior margin minutely serrate, with setae, posteroventral corner with small subacute spine, ventral margin without robust setae. Uropod 1 peduncle with 16 robust setae in two rows; distolateral robust seta absent; inner ramus shorter than outer ramus, with 6 marginal robust setae; outer ramus with 5 marginal robust setae. Uropod 2 peduncle with 10 robust setae in two rows; inner ramus longer than outer ramus, with 3 marginal robust setae; outer ramus with 3–4 marginal robust setae. Uropod 3 peduncle with 5 robust setae; ramus shorter than peduncle; triangular, narrowing distally; with 5 marginal setae and 4–5 apical setae. Telson longer than broad; incised to half length; with marginal and apical robust setae; about 3 to 5 robust setae per lobe.

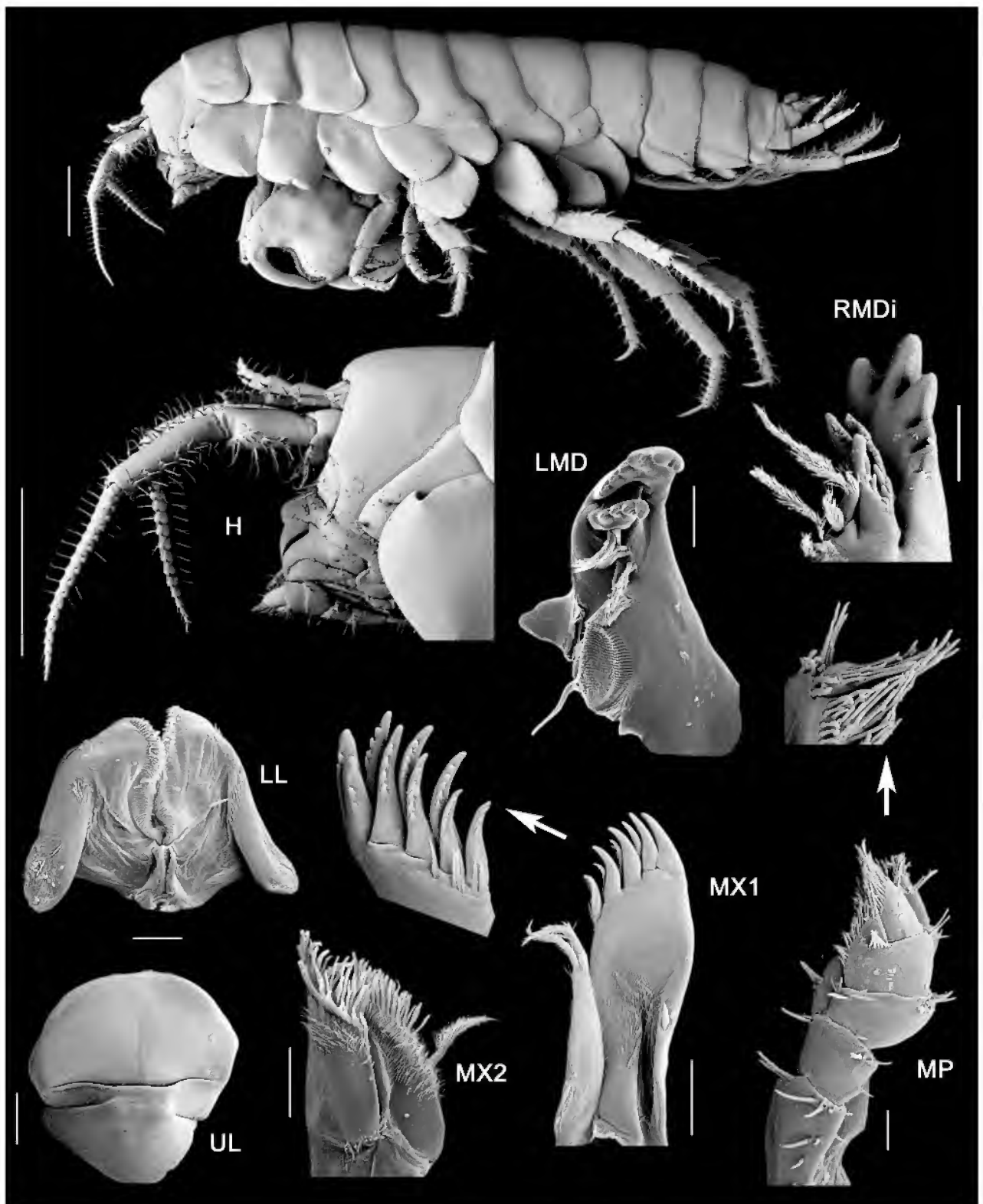


Fig. 13. *Notorchestia lobata* n.sp., paratype male, 10.8 mm, habitus, AM P69055; holotype male, 10.8 mm, other parts, AM P69051, Goolwa Beach, Encounter Bay, South Australia. Scales for habitus: 1 mm; remainder: 0.5 mm.

Female (sexually dimorphic characters), **11 mm**. Gnathopod 1 parachelate; posterior margin of merus, carpus and propodus without rugose lobe; propodus ovoid; palm very short, acute; dactylus longer than palm, with ventral row of setae. Gnathopod 2 mitten-shaped; basis slightly expanded;

about 1.5× longer than wide; merus with distally rounded posterodistal lobe on medial surface; palm obtuse; dactylus shorter than palm. Pereopod 7 basis with lateral sulcus slightly pronounced. Oostegites setae with simple and multi-furcate tips. Oostegites 2–4 moderately setose (around 24 setae).

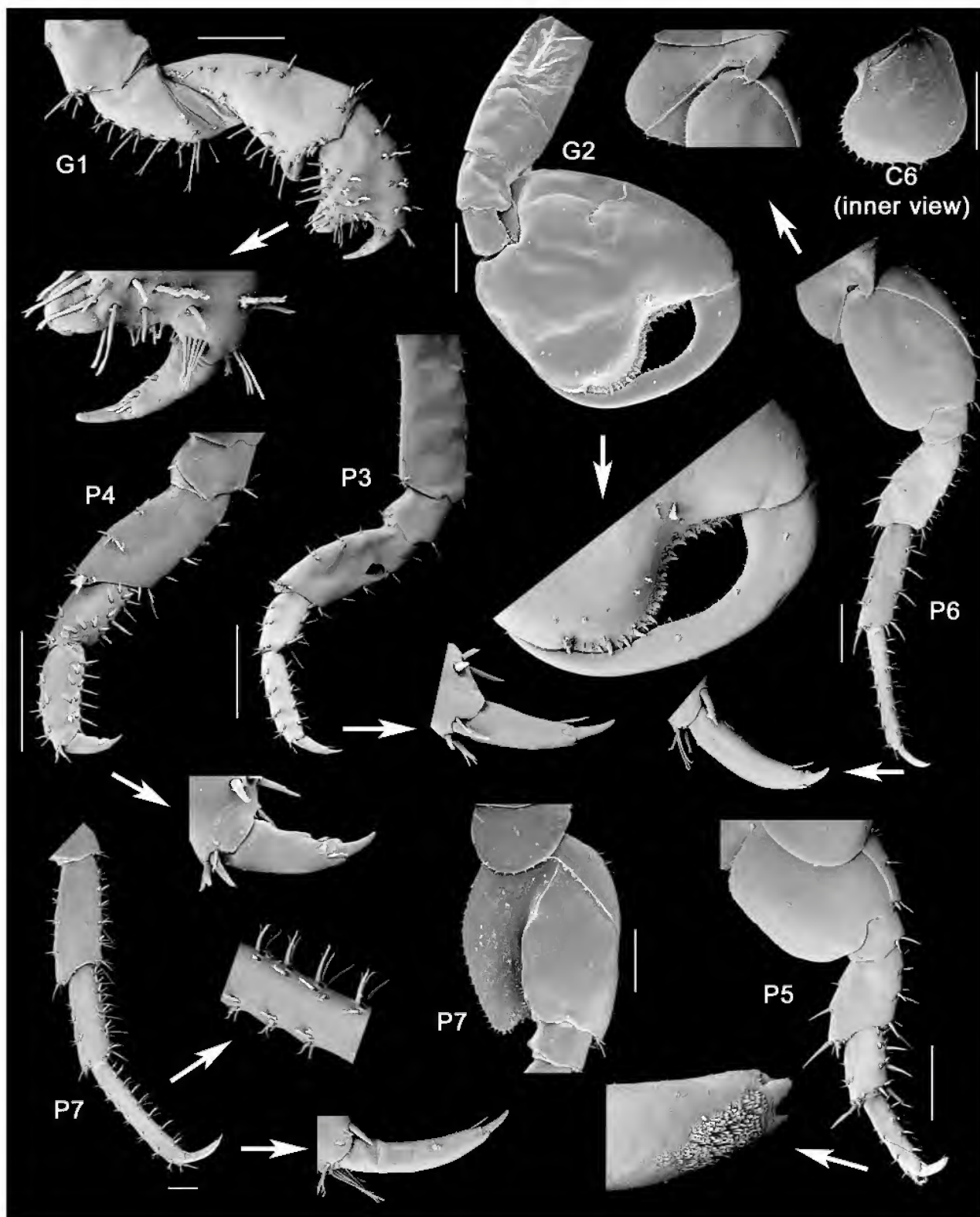


Fig. 14. *Notorchestia lobata* n.sp., holotype male, 10.8 mm, AM P69051, Goolwa Beach, Encounter Bay, South Australia. Scales represent 0.5 mm.

Variation. Juvenile males observed (7.9–10 mm) presented the gnathopod 2 with a distinct medial lobe on merus as seen in females, a lobe that reduces gradually in each moult, until disappearing completely in adult forms. The medial palm concavity of the gnathopod 2 is very shallow or imperceptible.

Habitat. Supra-littoral zone mainly on exposed ocean beaches, but also occurring in sheltered areas.

Remarks. *Notorchestia lobata* n.sp. is similar to *Orchestia quadrimana* (Dana, 1852), originally described from Illawarra, New South Wales. Both species have the shape

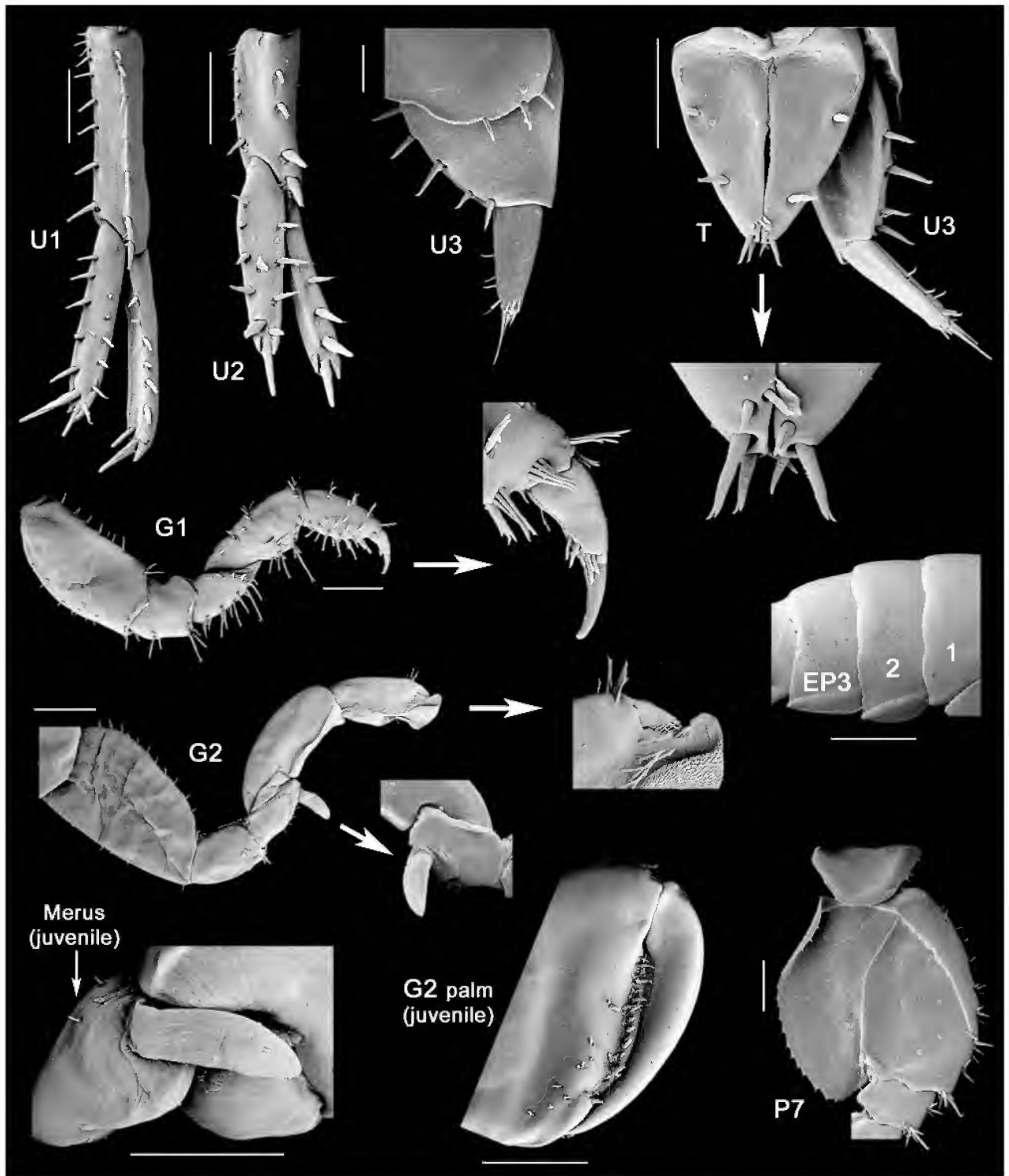


Fig. 15. *Notorchestia lobata* n.sp., holotype male, 10.8 mm, U3 and T, AM P69051; female, 9.1 mm, G1, AM P60956; female 11 mm, G2 and P7, AM P69052, juvenile male, 10 mm, G2, AM P69053, Goolwa Beach, Encounter Bay, South Australia. Scales for G1, G2, P7, U1–3: 0.3 mm; EP1–3: 1 mm; merus (juvenile) and T: 0.2 mm.

of propodus of male gnathopod 2 subquadrate with palm excavate. However, *N. lobata* has the outer ramus of uropod 1 with 5 robust setae, while *O. quadrimana* lacks marginal setae on outer ramus of uropod 1. Dana's (1852; 1853) description of *O. quadrimana* is poorly detailed and the species needs to be redescribed. Unfortunately, the type material appears to be lost (Ardis Jonston, in litt, from

the Museum of Comparative Zoology, Harvard) and our attempts to recollect this species from the type locality were unsuccessful.

Notorchestia lobata (Stebbing, 1899) is also close to *N. novaehollandiae* (Stebbing, 1899), originally described from Manly, New South Wales. Both species have setose antenna 2, subquadrate shape of propodus of male

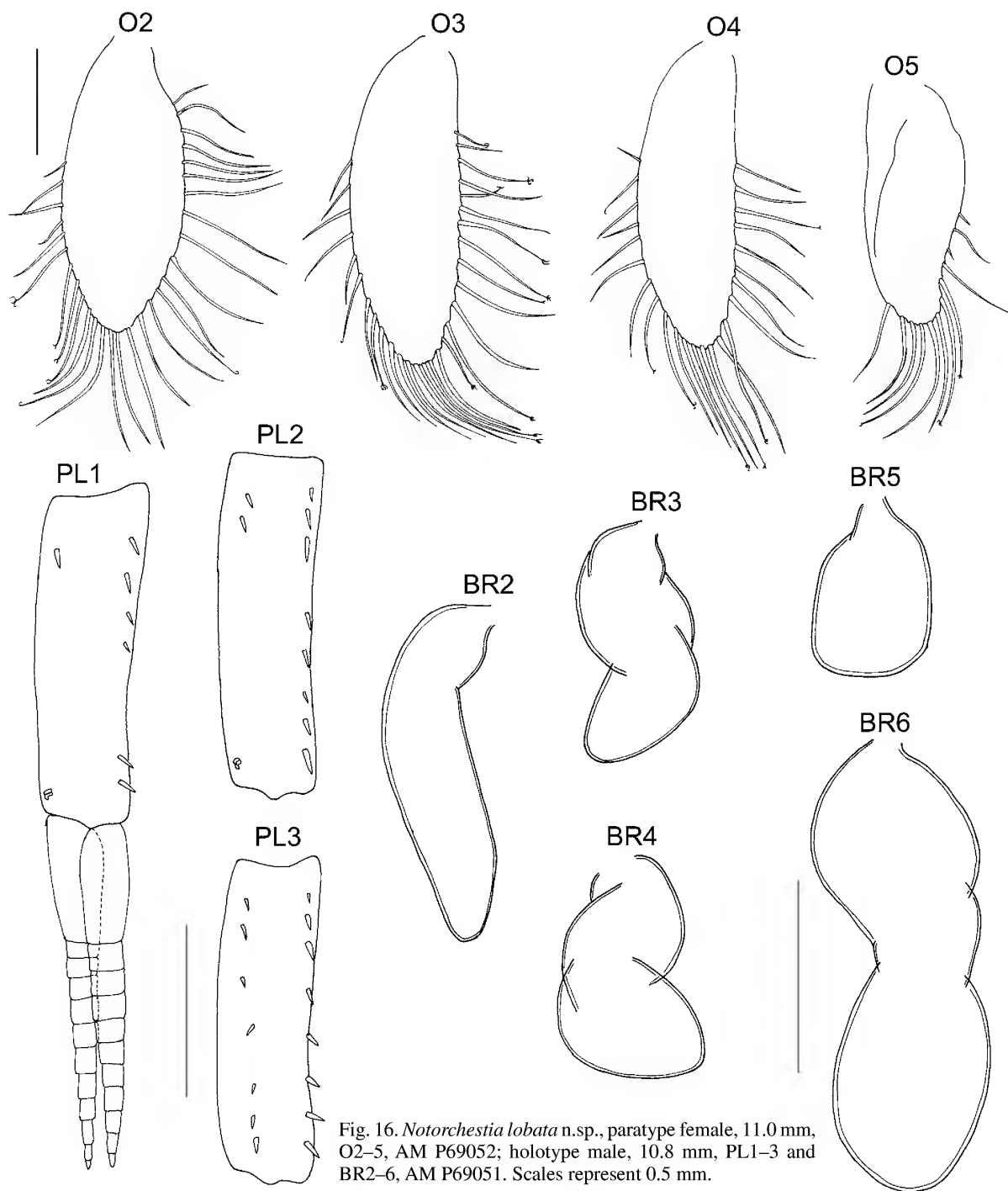


Fig. 16. *Notorchestia lobata* n.sp., paratype female, 11.0 mm, O2–5, AM P69052; holotype male, 10.8 mm, PL1–3 and BR2–6, AM P69051. Scales represent 0.5 mm.

gnathopod 2, basis of pereopod 7 with lateral sulcus and a cleft telson. Distinct differences are noticed on the male palm of gnathopod 2, which in *N. lobata* is strongly excavate (10.8 mm), not slightly excavate (10 mm); female palm of gnathopod 1 is parachelate, not simple; and the presence of the conspicuous lobe on the merus of female gnathopod 2, not described for *N. novaehollandiae*. The excavation on the palm of gnathopod 2 varies with the stage of development as noticed in *N. lobata*. Thus, the 10 mm male herein observed had a less excavate palm, but also had the medial lobe on the merus (Fig. 15), a character also not described for the *N. novaehollandiae* males.

Distribution. *Victoria*: Point Ricardo; Woodside Beach (between Sale and Yarram); Lorne Beach near mouth of Erskine River; Ocean Beach, Separation Creek; Peterborough Beach, Peterborough; Sandy Beach, The Craigs; Shelly Beach, Bridgewater Bay; Sandy Point. *South Australia*: Beachport Beach, Rivoli Bay; Goolwa Beach and Victor Harbour, Encounter Bay; Yankalilla Bay, Fleurieu Peninsula. *Western Australia*: Ocean Beach, Eucla; Fourth Beach, Esperance; West Beach, Hopetoun; Slippery Rock, Cape Leuwin; Binningup Beach, Bunbury; South Cottesloe Beach; Jurien Beach, Jurien; Disappointment Loop, Henri Freycinet Harbour, Shark Bay.

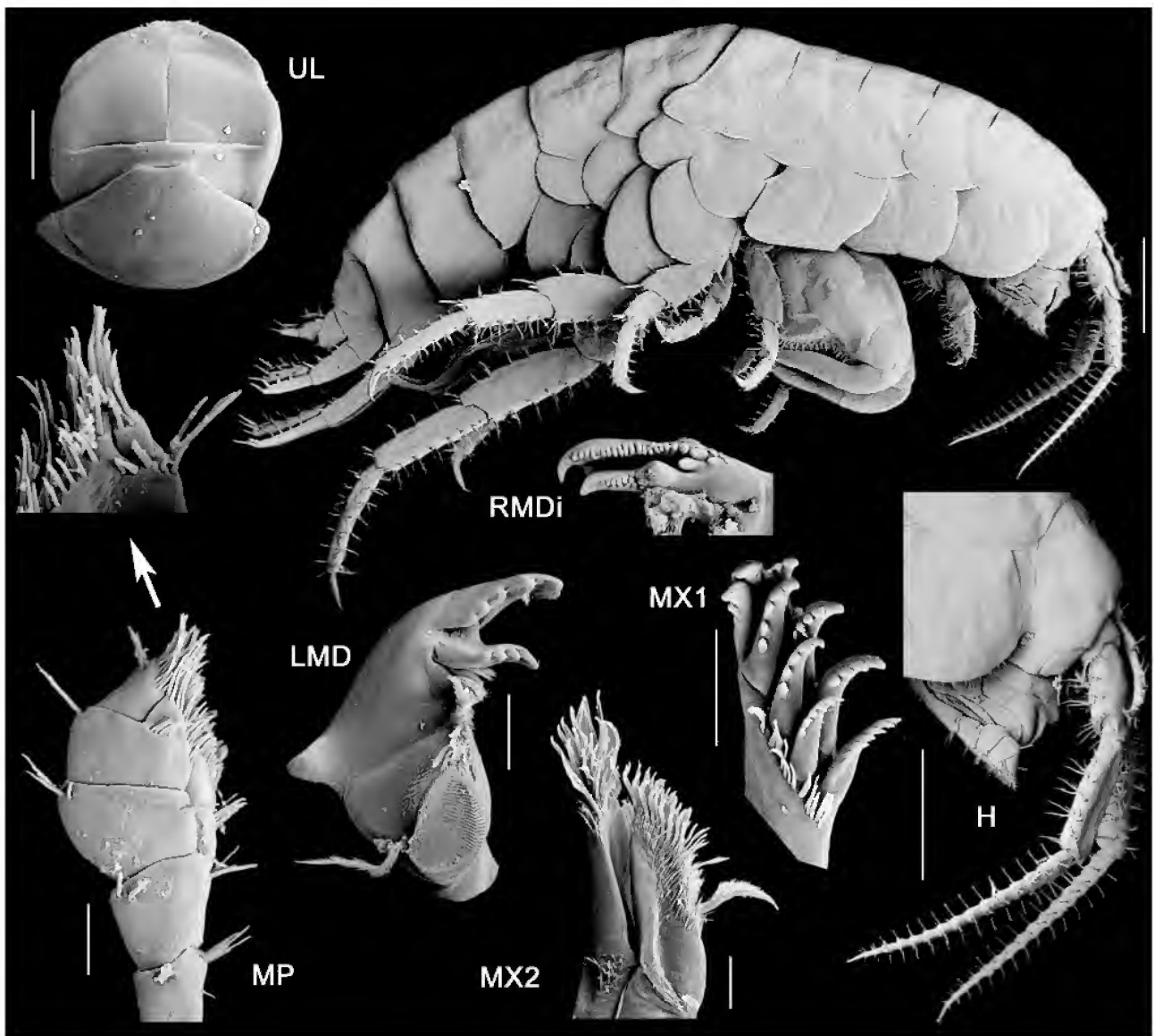


Fig. 17. *Notorchestia naturaliste* n.sp., paratype male, 16.2 mm, habitus, AM P69122; holotype male 14.8 mm, other parts, AM P69121, Bunker Bay, Cape Naturaliste, Western Australia. Scales for habitus: 1 mm; H: 0.5 mm; UL, MD, MX2, MP: 0.1 mm; MX1: 0.06 mm.

***Notorchestia naturaliste* n.sp.**

Figs 17–20

Type material. HOLOTYPE: male, 14.8 mm, AM P69121 (1 slide, stubs J046–J049–J052). PARATYPES: 1 male, 16.2 mm, AM P69122 (stub J061, habitus); 1 juvenile male, 15.5 mm, AM P69123; 1 female 14.6 mm, AM P69124; (stub J048, SEM micrographs); 10 males and 90 females, AM P69125; all from Bunker Bay, Cape Naturaliste, Western Australia (33°32.39'S 115°1.8'E), protected small rocky beach, C. Serejo & J.K. Lowry, 24 Oct. 2003, WA 760.

Type locality. Bunker Bay, Cape Naturaliste, Western Australia (33°32.39'S 115°1.8'E).

Additional material examined. *Western Australia*: 8 males and 30 females (multicoloured), AM P69126, Blackwood River mouth, Augusta (34°19.54'S 115°10.07'E), flat beach near boat ramp, substrate coarse dark sand with some tan

to orange and almost black pebbles, substrate covered with large patches of a green alga, probably *Enteromorpha*, C. Serejo & J.K. Lowry, 23 Oct. 2003, WA 758; 6 males and 52 females, AM P69127, Slippery Rock, Cape Leuwin (34°21.44'S 115°7.64'E), mixed and dead seaweed lodged between large boulders at the end of a steeply sloping white sand beach, C. Serejo & J.K. Lowry, 23 Oct. 2003, WA 759; 1 male, 1 female and 2 juvenile males, AM P69128, beach, Freshwater Point (29°36.34'S 114°58.42'E), small sandy beach with a lot of dead seagrass and seaweed adjacent to a rocky point, C. Serejo & J.K. Lowry, 28 Oct. 2003, WA 766; 6 males, AM P69129, Denham Beach, Denham, Shark Bay (25°56'S 113°32.53'E), white sandy beach with a strand of dead seagrasses at the high tide mark, C. Serejo & J.K. Lowry, 5 Nov. 2003, WA 776.

Etymology. This species is named for Cape Naturaliste, the type locality.

Diagnosis. Dactylus of gnathopod 1 with row of ventral

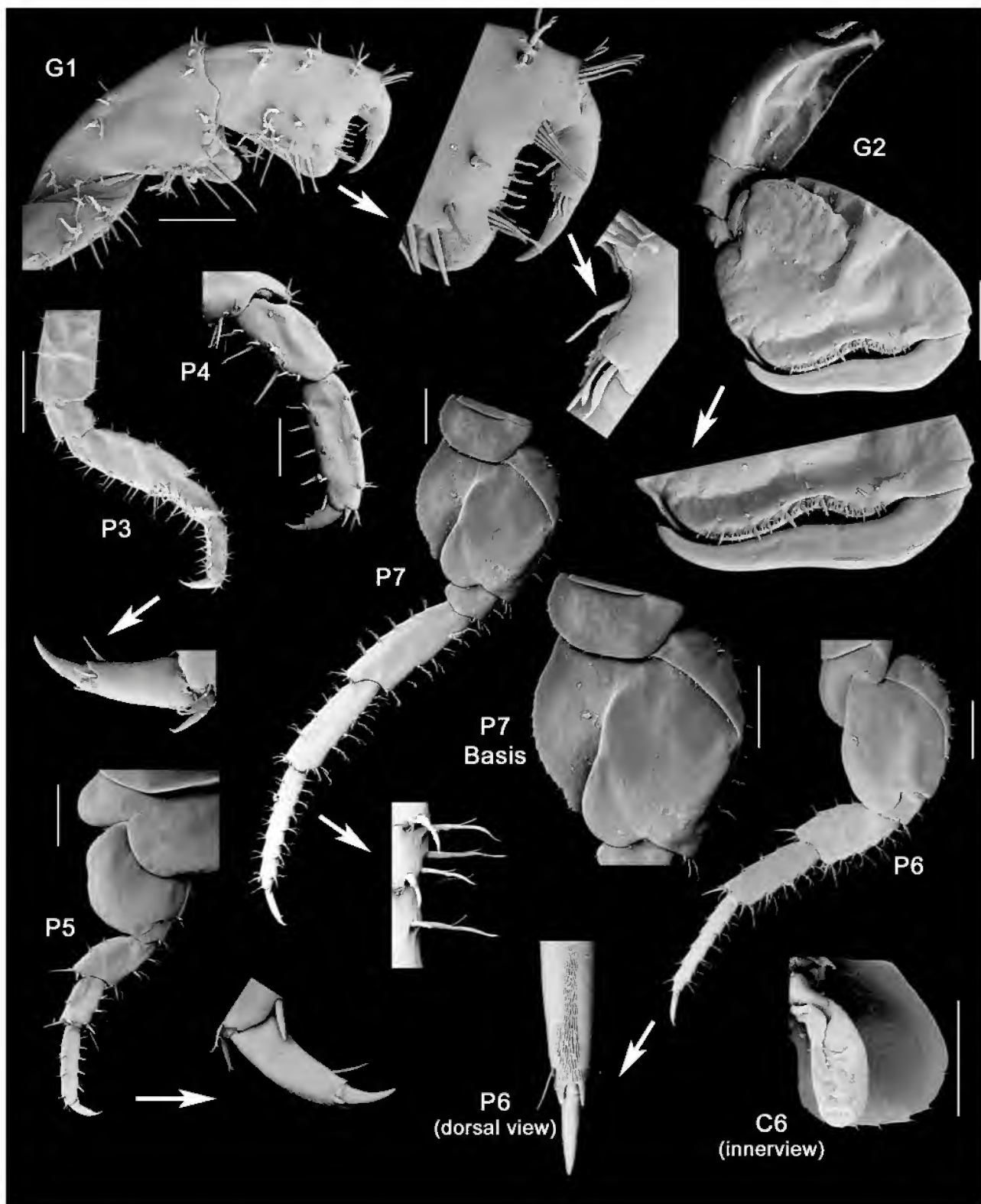


Fig. 18. *Notorchestia naturaliste* n.sp., holotype male, 14.8 mm, AM P69121, Bunker Bay, Cape Naturaliste, Western Australia. Scales for G1 and P4: 0.2 mm; remainder: 0.5 mm.

short setae. Female and male juvenile gnathopod 2 merus with distally pointed posterodistal medial lobe. Gnathopod 2 male, propodus subtriangular; palm acute and sinuous. Coxa 6 posterior lobe posteroventral margins with 6–7 robust setae. Basis of pereopod 7 with lateral sulcus. Telson cleft to half length.

Description

Holotype male, 14.8 mm. Eye medium, $\frac{1}{5}$ – $\frac{1}{3}$ head length. Antenna 1 short, rarely longer than peduncle article 4 of antenna 2. Antenna 2 shorter than head and first 3 pereonites; peduncular articles narrow; with many robust setae; article

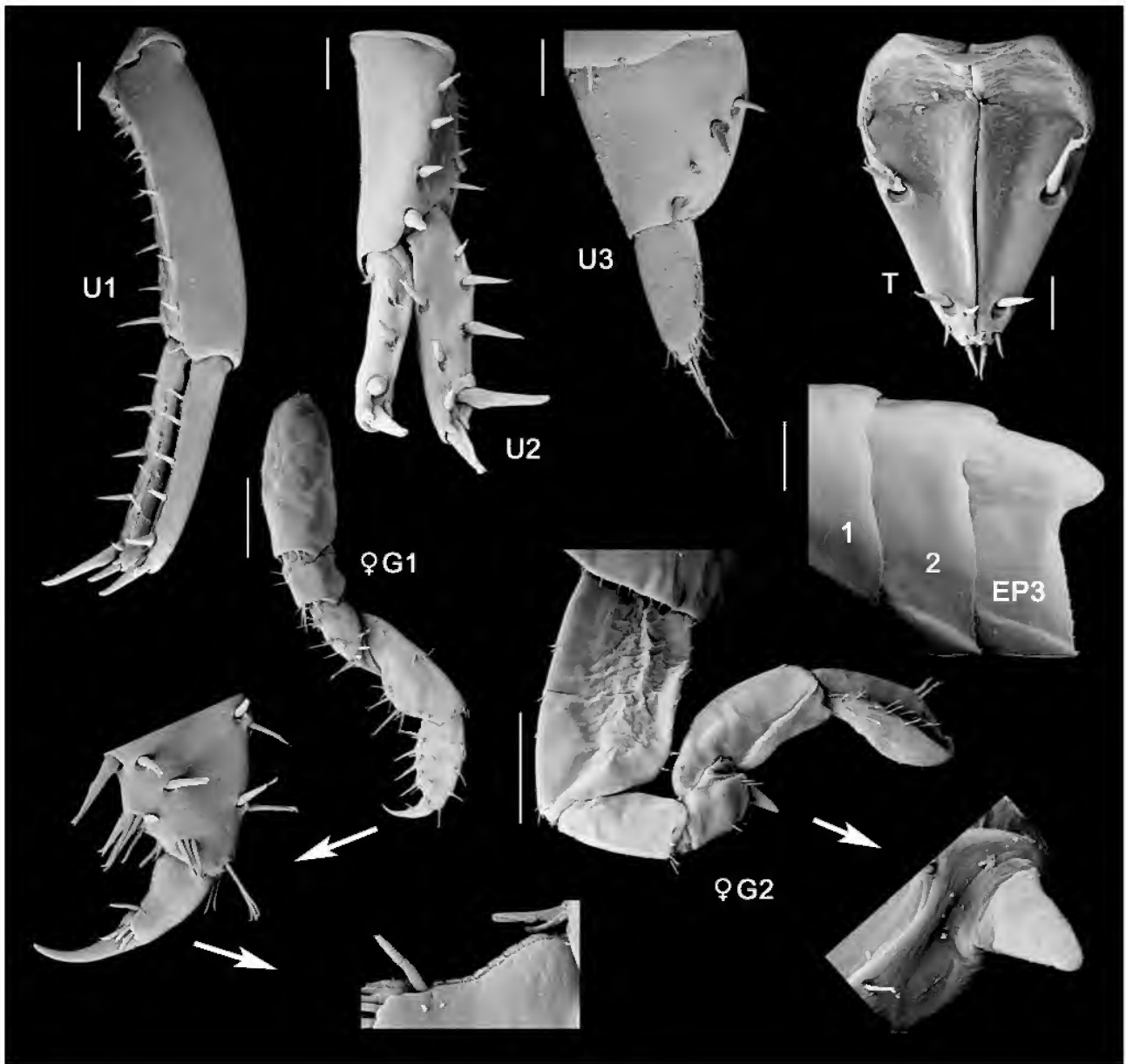


Fig. 19. *Notorchestia naturaliste* n.sp., holotype male, 14.8 mm, U1–3, EP1–3, T, AM P69121, paratype female, 14.6 mm, G1–2, AM P69124, Bunker Bay, Cape Naturaliste, Western Australia. Scales for U1–3: 0.2 mm; G1–2: 0.3 mm; EP1–3: 0.5 mm; T: 0.1 mm.

5 longer than article 4. Epistome of upper lip without robust setae. Lower lip distolateral setal tuft absent. Mandible left lacinia mobilis 4-dentate. Maxilliped palp article 2 with distomedial lobe, article 4 present, reduced.

Gnathopod 1 sexually dimorphic; subchelate; posterior margin of carpus and propodus with rugose lobe; propodus sub-triangular; palm transverse; dactylus shorter than palm, with row of ventral short setae. Gnathopod 2 sexually dimorphic; subchelate; merus without posterodistal medial lobe; carpus triangular, reduced, enclosed by merus and propodus; propodus sub-triangular; palm acute, sinuous, with small midpalmar concavity, posterodistal corner without protuberance; dactylus longer than palm, not attenuated distally. Coxae 2–4 as wide as deep. Pereopods 3–7 cuspidactylate; dactylus with row or patch of dorsal short setae. Pereopod 4 significantly shorter than pereopod 3. Pereopod 4 dactylus thickened and pinched posteriorly, different to pereopod 3 dactylus. Pereopod 5 propodus distinctly longer than carpus.

Pereopod 6 not sexually dimorphic; shorter than pereopod 7; coxa posterior lobe anterodistal corner rounded, posteroventral margins with 6–7 robust setae, outer surface with ridge. Pereopod 7 sexually dimorphic; basis with lateral sulcus well developed, posterodistal lobe absent; distal articles slender. Coxal gills simple or slightly lobate. Pereopods 3–5 gills smaller than gills 2 and 6.

Pleopods 1–3 well developed, biramous. Pleopod 1 peduncle without setae; pleopods 2–3 peduncles with 5–6 short marginal robust setae. Epimeron 2 subequal in length to epimeron 3. Epimeron 3 posterior margin with setae, posteroventral corner with small subacute spine. Uropod 1 peduncle with 12 robust setae in two rows; distolateral robust seta absent; inner ramus subequal in length to outer ramus; inner ramus with 4 marginal robust setae; outer ramus with 4 marginal robust setae. Uropod 2 peduncle with 11 robust setae in two rows; inner ramus subequal in length to outer ramus, with 5 marginal robust setae; outer ramus with 2 marginal

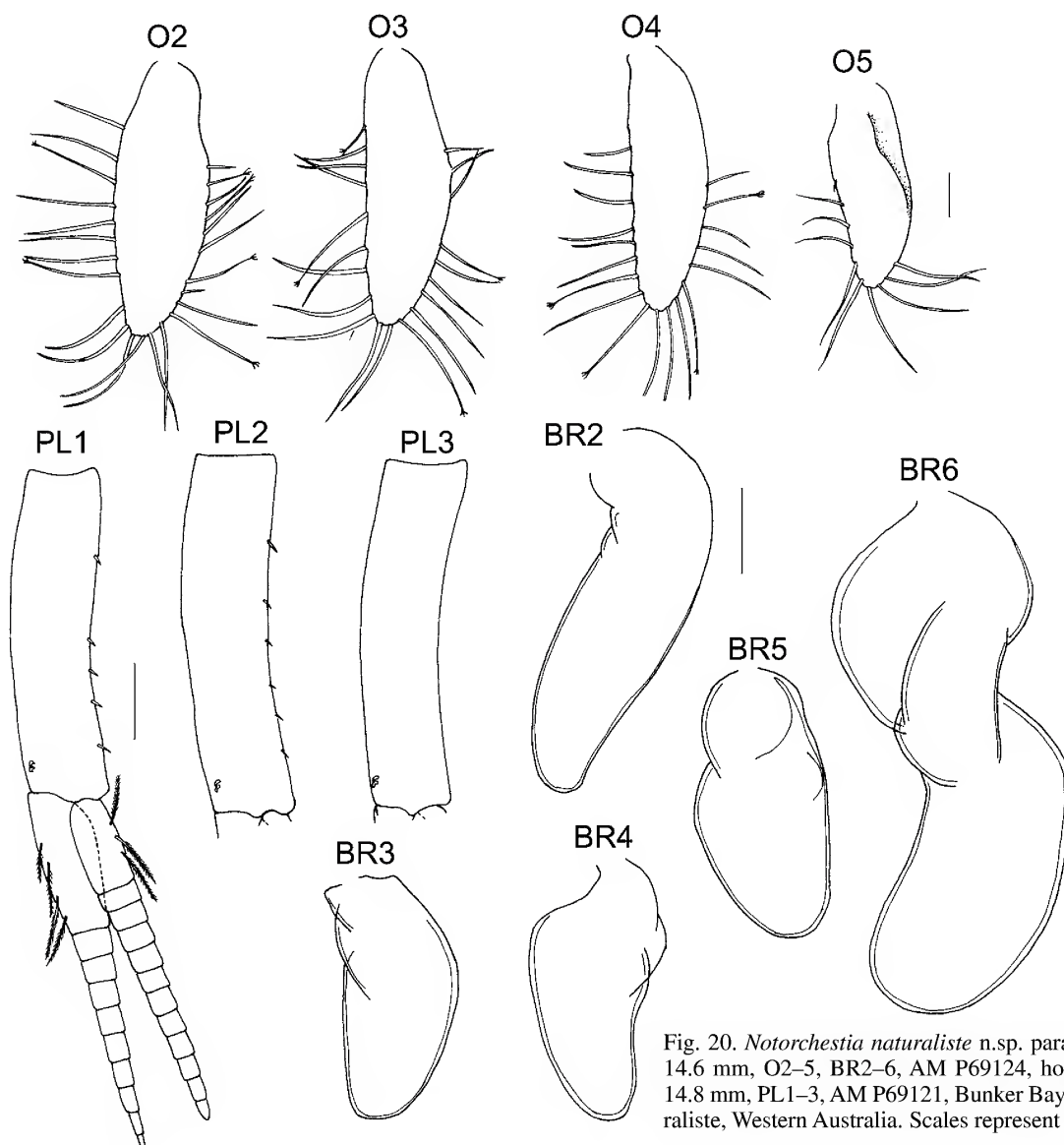


Fig. 20. *Notorchestia naturaliste* n.sp. paratype female 14.6 mm, O2–5, BR2–6, AM P69124, holotype male, 14.8 mm, PL1–3, AM P69121, Bunker Bay, Cape Naturaliste, Western Australia. Scales represent 0.2 mm.

robust setae. Uropod 3 peduncle with 4 robust setae; ramus shorter than peduncle; oval to spatula-shape, broad distally; ramus with 5–6 marginal setae and 4–5 apical setae. Telson longer than broad; incised to half length; with marginal and apical robust setae, about 3 to 5 robust setae per lobe.

Female (sexually dimorphic characters), 14.6 mm. Gnathopod 1 parachelate; posterior margin of merus, carpus and propodus without rugose lobe; propodus ovoid; palm very short, acute; dactylus longer than palm, with row of ventral short setae. Gnathopod 2 basis slightly expanded, about 2× longer than wide; merus with distally pointed posterodistal medial lobe; palm obtuse, smooth; dactylus shorter than palm. Pereopod 7 basis with lateral sulcus slightly pronounced. Oostegites longer than wide; setae with simple and/or multi-furcate tips. Oostegites 2–4 moderately setose (around 24 setae).

Variation. In juvenile males the process on the merus of gnathopod 2 may be present; the palm of gnathopod 2 is nearly straight and the sulcus on basis of pereopod 7 is slightly pronounced.

Remarks. *Notorchestia naturaliste* n.sp. resembles *N. lobata* n.sp. in the short antenna 1; heavily setose antenna 2; male gnathopod 1 subchelate, with rugose lobe on carpus and propodus; basis of pereopod 7 with lateral sulcus; and cleft telson. However, *N. naturaliste* can be distinguished from *N. lobata* by the sub-triangular shape of propodus of gnathopod 2 (not subquadrate), palm of gnathopod 2 with shallow concavity (not strong concavity in adult males); coxa 6 posterior lobe posteroventral margins with 6–7 robust setae, (not 14–15 setae); basis of pereopod 7 without posteroventral lobe on posterior margin, but with a frontal facial lobe formed from the sulcus (Fig. 18). *Notorchestia naturaliste* n.sp. occurred only in Western Australia and was found living sympatrically with *N. lobata* at Slippery Rock, Cape Leuwin.

Distribution. *Western Australia:* Blackwood River mouth; Slippery Rock, Cape Leuwin; Bunker Bay, Cape Naturaliste; Freshwater Point; Denham Beach, Denham, Shark Bay.

***Platorchestia* Bousfield, 1982**

Platorchestia Bousfield, 1982: 26; Jo, 1988: 160; Richardson, 1991: 186; Miyamoto & Morino, 2004: 68; Serejo, 2004: 20.

Type species. *Platorchestia platensis* (Krøyer, 1845).

Diagnosis. Antenna 2 not geniculate, occasionally sexually dimorphic. Mandible left lacinia mobilis 5-dentate. Maxillipedal palp dactylus present, reduced. Gnathopod 2 subchelate; basis narrow or slightly expanded; propodus palm posterodistal corner without protuberance. Pereopods 3–7 cuspidactylate. Pereopod 4 carpus similar in length to or significantly shorter than carpus of pereopod 3. Pereopod 6 sexually dimorphic, or not. Pereopod 7 sexually dimorphic; basis lateral sulcus present, slightly pronounced. Gills lobate and/or convoluted; gills 3–5 smaller than gills 2 and 6. Oostegites 2–5 setae with simple straight tips. Pleopods all well developed. Uropod 1 outer ramus without marginal robust setae. Uropod 2 outer ramus with marginal robust setae. Telson entire, as long as or longer than broad with 3–10 robust setae per lobe.

Species composition. *Platorchestia* contains 16 species: *P. ashmoleorum* Stock, 1996; *P. bousfieldi* Ho & Li, 2003; *P. chathamensis* Bousfield, 1982; *P. humicola* (Martens, 1868); *P. japonica* (Tattersall, 1922); *P. joi* Stock & Biernbaum, 1994; *P. kaalensis* (Barnard, 1955); *P. lanipo* Richardson, 1991; *P. monodi* Mateus *et al.*, 1986; *P. munmui* Jo, 1988; *P. pachypus* (Derzhavin, 1937); *P. pacifica* Miyamoto & Morino, 2004; *P. paraplatisensis* n.sp.; *P. pickeringi* (Dana, 1853); *P. platensis* (Krøyer, 1845) and *P. zachsi* (Derzhavin, 1937).

***Platorchestia paraplatisensis* n.sp.**

Figs 21–24

Type material. HOLOTYPE: male, 19.3 mm AM P69144 (slides, stubs J037–J042, J043 [part P7]). PARATYPES: male, 15.1 mm (stub J044, habitus) AM P69145; 1 female, 12.5 mm, AM P69146 (1 slide, stub J036, SEM micrographs); 355 specimens, AM P69147, juvenile male, 11 mm, AM P69149 (stub J043 [part, G2]); west of Blackwell Reach, Swan River, Perth (32°1.91'S 115°45.72'E), flat beach with stones and large patches of *Enteromorpha*, C. Serejo, J.K. Lowry & D. Jones, 26 Oct. 2003, WA 763; 242 specimens, AM P69148, east of Point Walter, Swan River, Perth, (32°01'S 115°47'E), flat sandy beach with large patches of *Enteromorpha*, C. Serejo, J.K. Lowry & D. Jones, 26 Oct. 2003, WA 764.

Etymology. This species named “paraplatisensis” indicates its similarity to *P. platensis*.

Diagnosis. Male antenna 2 and pereopod 7 strongly sexually dimorphic. Male gnathopod 1 cuspidactylate. Coxa 6 posterior lobe with anterodistal corner subquadrate, with process, 1–2 marginal setae, posterior margin perpendicular to ventral margin, outer surface with ridge. Pleopod 2 with 3 median marginal robust setae; pleopod 3 with 3 distal marginal robust setae.

Description

Male. 15.1–19.3 mm. Eye medium, $\frac{1}{5}$ – $\frac{1}{3}$ head length. Antenna 1 short, rarely longer than article 4 of antenna 2. Antenna 2 shorter than head and first 3 pereonites; peduncular articles expanded; peduncular articles with sparse, small robust setae. Lower lip distolateral setal tuft absent. Mandible left lacinia mobilis 5-dentate. Maxillipedal palp, article 2 with mediobasal lobe, article 4 present, reduced.

Gnathopod 1 sexually dimorphic; subchelate; posterior margin of carpus and propodus with rugose lobe; propodus subtriangular; palm transverse; dactylus slightly shorter than palm, without ventral setal row, cuspidactylate. Gnathopod 2 sexually dimorphic; subchelate; basis slightly expanded; merus without medial lobe; carpus triangular, reduced, enclosed by merus and propodus; palm acute, with well-developed midpalmar notch, posterodistal corner without protuberance; dactylus fit into a sulcus internally and narrowed distally. Coxae 2–4 as wide as deep. Pereopods 3–7 cuspidactylate; dactylus without row or patch of dorsal short setae. Pereopod 4 significantly shorter than pereopod 3. Pereopod 4 dactylus thickened and pinched posteriorly, different to pereopod 3 dactylus. Pereopod 5 propodus distinctly longer than carpus. Pereopod 6 not sexually dimorphic, shorter than pereopod 7; coxa 6 posterior lobe with anterodistal corner subquadrate, with process, and with 1–2 marginal setae, posterior margin perpendicular to ventral margin, outer surface with ridge; carpus slender. Pereopod 7 sexually dimorphic; basis without lateral sulcus, posterodistal lobe present; distal articles expanded; carpus oblong. Coxal gills convoluted or simple. Pereopods 3–5 gills smaller than gills 2 and 6.

Pleopods 1–3 well developed, biramous; peduncle slender. Pleopod 1 peduncle without marginal setae. Pleopod 2 peduncle with 3 marginal robust setae and one slender seta. Pleopod 3 peduncle with 3 subdistal robust setae. Epimera 1–3 with posterior margin slightly serrated, posteroventral corner of epimera 1–2 produced. Uropod 1 peduncle with 15 robust setae in two rows, distolateral robust seta absent; inner ramus subequal in length to outer ramus and with 4 marginal inner setae and 3 marginal outer setae; outer ramus without robust setae. Uropod 2 peduncle inner margin with 7–10 setae and outer margin with 3–4 setae; inner ramus subequal in length to outer ramus; inner ramus with 3 marginal inner setae and 2 marginal outer setae; outer ramus with 1–2 marginal robust setae. Uropod 3 peduncle with 2–3 robust setae; ramus subequal in length to peduncle, triangular, narrowing distally; with 2 marginal setae, and 4–5 apical setae. Telson longer than broad, apically incised, with marginal and apical robust setae; each lobe with 3–5 robust setae; dorsal midline entire.

Female (sexually dimorphic characters), 12.5 mm. Antenna 2 peduncular articles narrow. Gnathopod 1 parachelate; posterior margin of merus, carpus and propodus with rugose lobe vestigial or absent; propodus subrectangular; palm acute; dactylus much longer than palm. Gnathopod 2 mitten-shaped; basis produced proximally, 1.7× longer than wide, posterior margin of merus, carpus and propodus with rugose lobe; palm obtuse, smooth; dactylus shorter than palm. Pereopod 7 distal articles slender. Oostegites setae with simple straight tips. Oostegites 2–4 moderately setose (around 24 setae). Oostegite 5 with about 11 setae, posterior

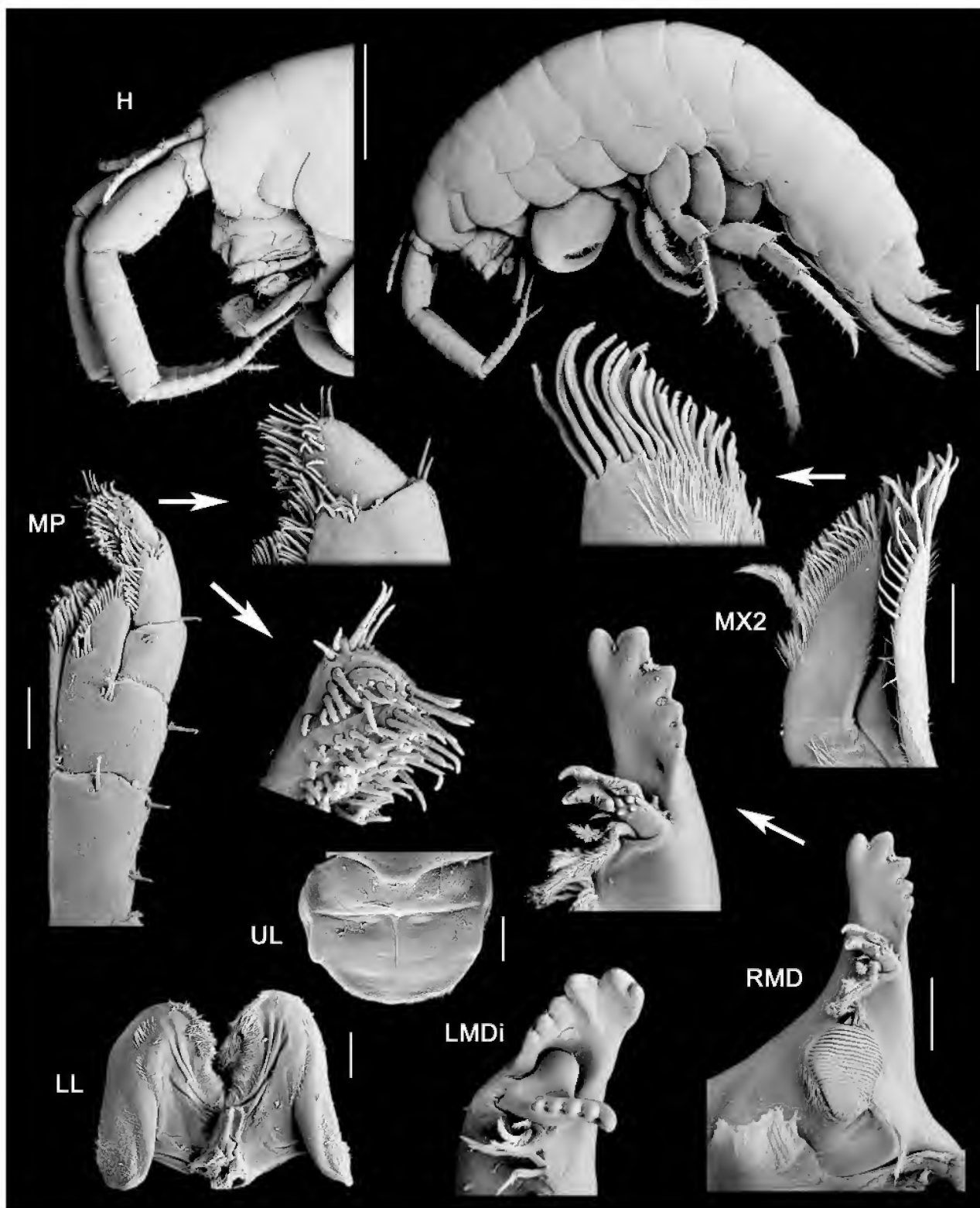


Fig. 21. *Platorchestia parapatensis* n.sp., paratype male, 15.1 mm, habitus and H, AM P69145, holotype male, 19.3 mm, other parts, AM P69144, Blackwell Reach, Swan River, Perth, Western Australia. Scales for habitus and H: 1 mm; remainder: 0.1 mm.

margin with fewer setae than anterior margin. Uropod 2 peduncle inner margin with 4–6 setae.

Habitat. Under *Enteromorpha* sp. on the margin of Swan River, brackish water.

Remarks. The genus *Platorchestia* includes supra-littoral and terrestrial species, which is reflected by a degree of sexual dimorphic characters in male antenna 2 and pereopod 7 as pointed recently by Miyamoto & Morino (2004). Attempts to elucidate the *P. platensis* complex started with Jo (1988), who compared *P. platensis* based on material from Denmark,



Fig. 22. *Platorchestia paraplatis* n.sp., holotype male, 19.3 mm, AM P69144, Blackwell Reach, Swan River, Perth, Western Australia. Scales represent 0.5 mm.

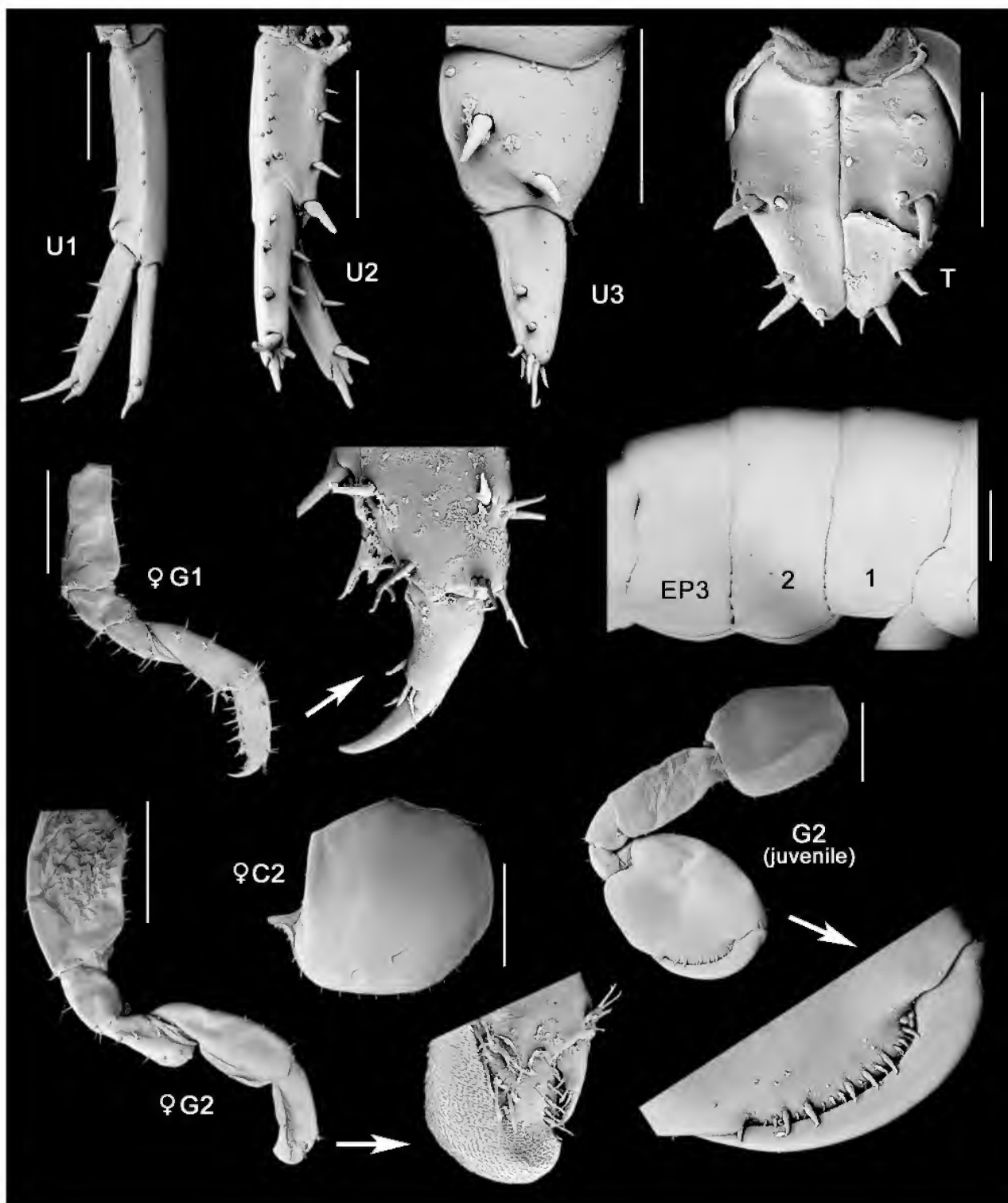


Fig. 23. *Platorchestia paraplatis* n.sp., holotype male, 19.3 mm, U1–3, T, EP1–3, AM P69144; paratype female, 12.5 mm, G1–2, AM P69146; juvenile male, 11.0 mm, G2, AM P69149, Blackwell Reach, Swan River, Perth, Western Australia. Scales for U3, T: 0.2 mm; remainder: 0.5 mm.

the Netherlands and Florida with previous identifications of *P. platensis* from the Western Pacific and other similar species. Serejo (2004) did a list of the 13 species included in the genus and also compared *P. platensis*, based on the type material from Montevideo, Uruguay, with the Atlantic *P. monodi* (Mateus *et al.*, 1986) found on the Brazilian coast. Recently Miyamoto & Morino (2004) described the supra-

littoral *Platorchestia pacifica* from Taiwan comparing it to *P. platensis* (from Kent, England) and allies. Miyamoto & Morino (2004) divided *Platorchestia* into three groups according to the sexual dimorphism in antenna 2 and pereopod 7. *Platorchestia paraplatis* n.sp. is part of group 1, which includes species with strong sexual dimorphism in antenna 2 and pereopod 7 including *P. joi* Stock & Biernbaum, 1994; *P.*

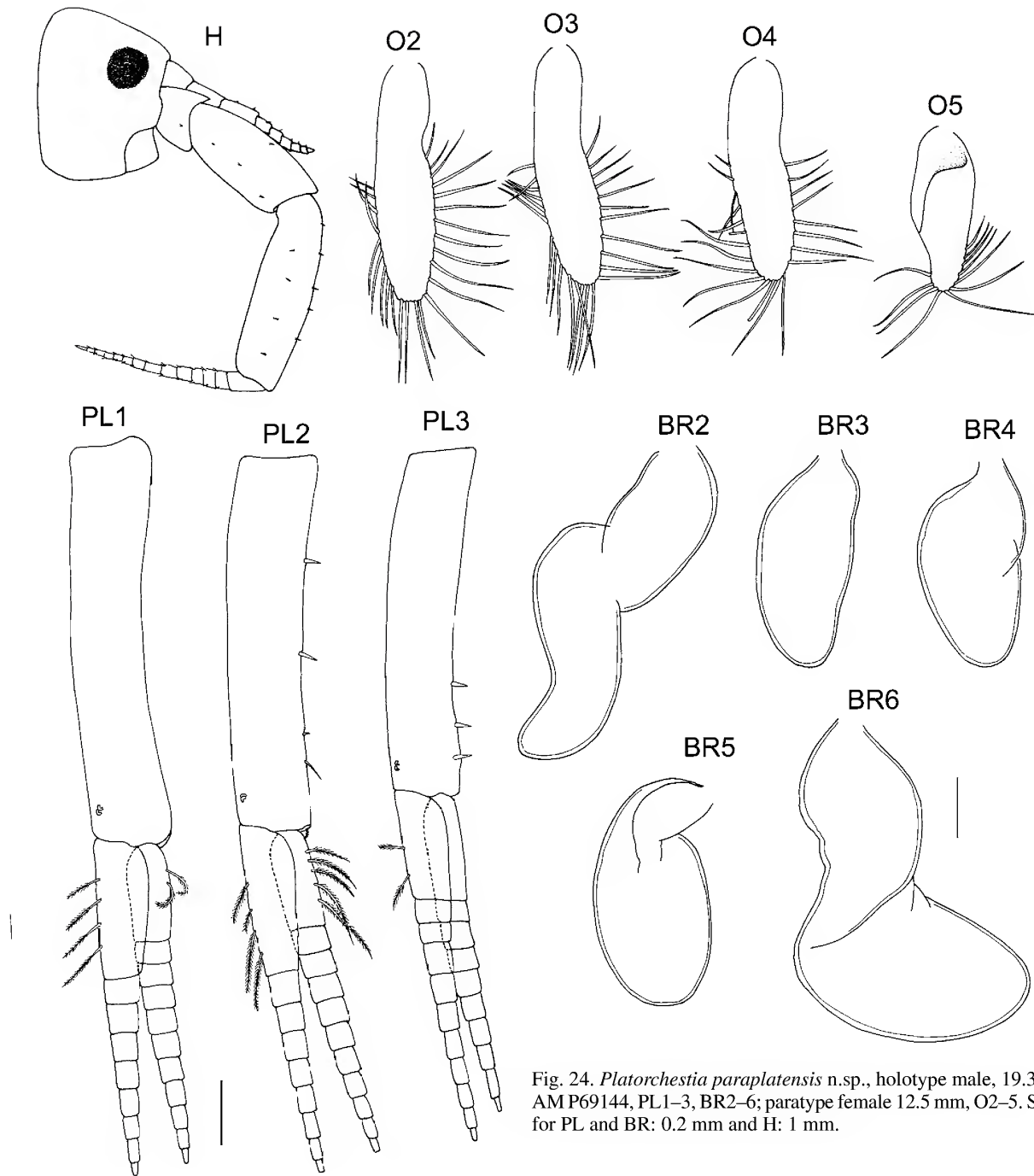


Fig. 24. *Platorchestia paraplatis* n.sp., holotype male, 19.3 mm, AM P69144, PL1–3, BR2–6; paratype female 12.5 mm, O2–5. Scales for PL and BR: 0.2 mm and H: 1 mm.

munmui Jo, 1988, *P. pacifica*; *P. pachypus* (Derzhavin, 1937) and *P. platensis*. These species are generally found on the supralittoral zone of beaches, mouth of rivers, estuaries etc. Three of these species, *P. pacifica*, *P. platensis* and *P. paraplatis* n.sp., have gnathopod 1 cuspidactylate, and the anterodistal corner of posterior lobe of coxa 6 with process. The outer plate of maxilla 2 with pectinate setae was pointed out by Miyamoto & Morino (2004) as diagnostic for *P. pacifica*, and can also be seen in *P. paraplatis* n.sp. and in the types of *P. platensis*. Although similar to the Atlantic *P. platensis* and *P. pacifica* in the characters above, the Australian species can be distinguished from these species by pleopod 2 bearing 3 marginal median setae versus 3 marginal proximal seta

on *P. pacifica* and 4 marginal median setae on *P. platensis*; pleopod 3 with 3 marginal distal setae, versus 9 marginal setae and 6 facial on *P. pacifica* and 4 marginal distal setae on *P. platensis*. Also the gnathopod 2 notch is well defined and the dactylus is narrowed distally when compared with the *P. platensis* lectotype 12.3 mm (Serejo, 2004, fig. 10), which has male gnathopod 2 palm sinuous, lacking a conspicuous notch with dactylus not narrowing distally. Oostegite 5 has around 11 setae and the posterior margin has fewer setae than anterior margin, compared with *P. pacifica*, which has 8 setae distributed evenly on both sides.

Distribution. Western Australia: Swan River.

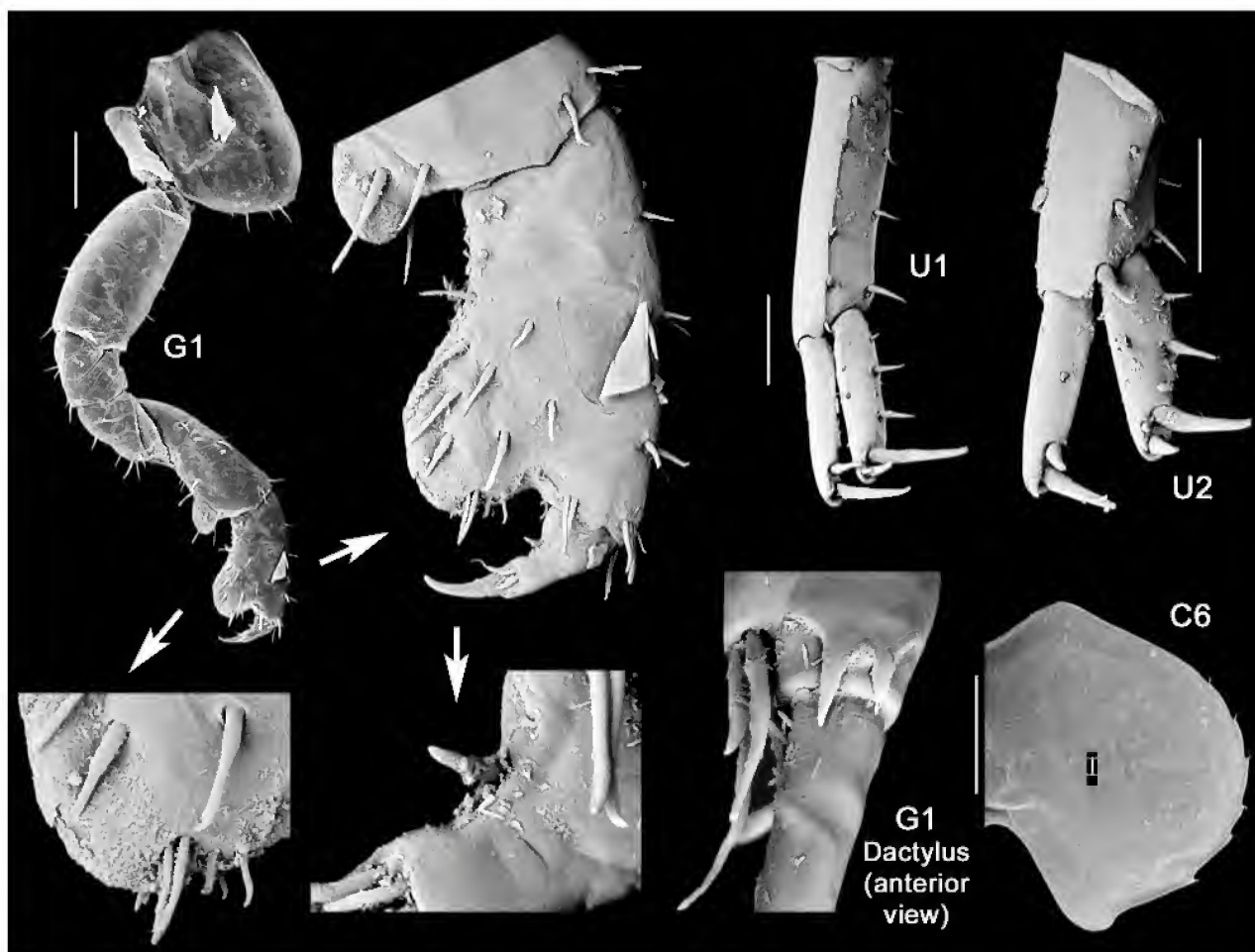


Fig. 25. *Platorchestia platensis* (Krøyer, 1845), paralectotype male, 6.8 mm, ZMUC CRU 7803, Montevideo, Uruguay. Scales represent 0.2 mm.

Platorchestia platensis (Krøyer, 1845)

Figs 25–26

Platorchestia platensis.—Stock, 1996: 153, Figs 2D, 3D; Jo, 1988: 166, fig. 8; Miyamoto & Morino, 2004: 81: fig. 7; Serejo, 2004: 19: fig. 10.

Material examined. Type material of *Orchestia platensis* Krøyer, 1854, PARALECTOTYPES: male, 6.8 mm, female, 7.6 mm, ZMC CRU7803, Rio de la Plata, Montevideo, Uruguay.

Diagnosis. Outer plate of maxilla 2 with pectinate setae. Male antenna 2 and pereopod 7 strongly sexually dimorphic. Carpus of pereopod 7 incrassate, laterally elliptic. Male gnathopod 1 cuspidactylate. Male gnathopod 2 with palm sinuous, lacking conspicuous notch; dactylus not narrowing distally. Coxa 6 posterior lobe with anterodistal corner subquadrate, with process, 1–3 marginal setae, posterior margin perpendicular to ventral margin. Pleopod 1 lacking marginal setae. Pleopod 2 with 4 median marginal robust setae; pleopod 3 with 4 median marginal robust setae. Coxal gills convoluted or simple. Pereopods 3–5 gills smaller than gills 2 and 6. Oostegites 2–4 moderately setose (around 20 setae). Oostegite 5 with 9 setae, posterior margin with fewer setae than anterior margin.

Remarks. Considering the similarity of *P. platensis* with *P. paraplatensis* n.sp. herein described, other characters, based on the lectotype, such as shape of coxa 6, oostegite 5 setae, and number of setae on pleopods of the former species were observed and used to differentiate these taxa as discussed above. Recent studies on *Platorchestia*, including *P. platensis*, were based on material from Europe (Jo, 1988; Miyamoto & Morino, 2004), despite the fact that the type locality of this species is Montevideo, Uruguay. Small differences were noted when comparing the type material with some European redescrptions of *P. platensis*, such as the dactylus of gnathopod 2, which is narrowing distally in material from Kent, England (Miyamoto & Morino, 2004) (versus not narrowing), the palm of gnathopod 2, which is notched (versus sinuous), and the dactylus of gnathopod 1 in Denmark specimens (Jo, 1988), which fits the palm (versus shorter). As new characters of the *P. platensis* complex come to light it is important for future studies on the group to show clearly the diagnostic features noted herein for an accurate assessment. For the time being, we consider the European species as *P. platensis*, although a careful examination from the southern population of Montevideo with the European specimens may prove that we are dealing with different taxa. Genetic studies would be helpful in this case.

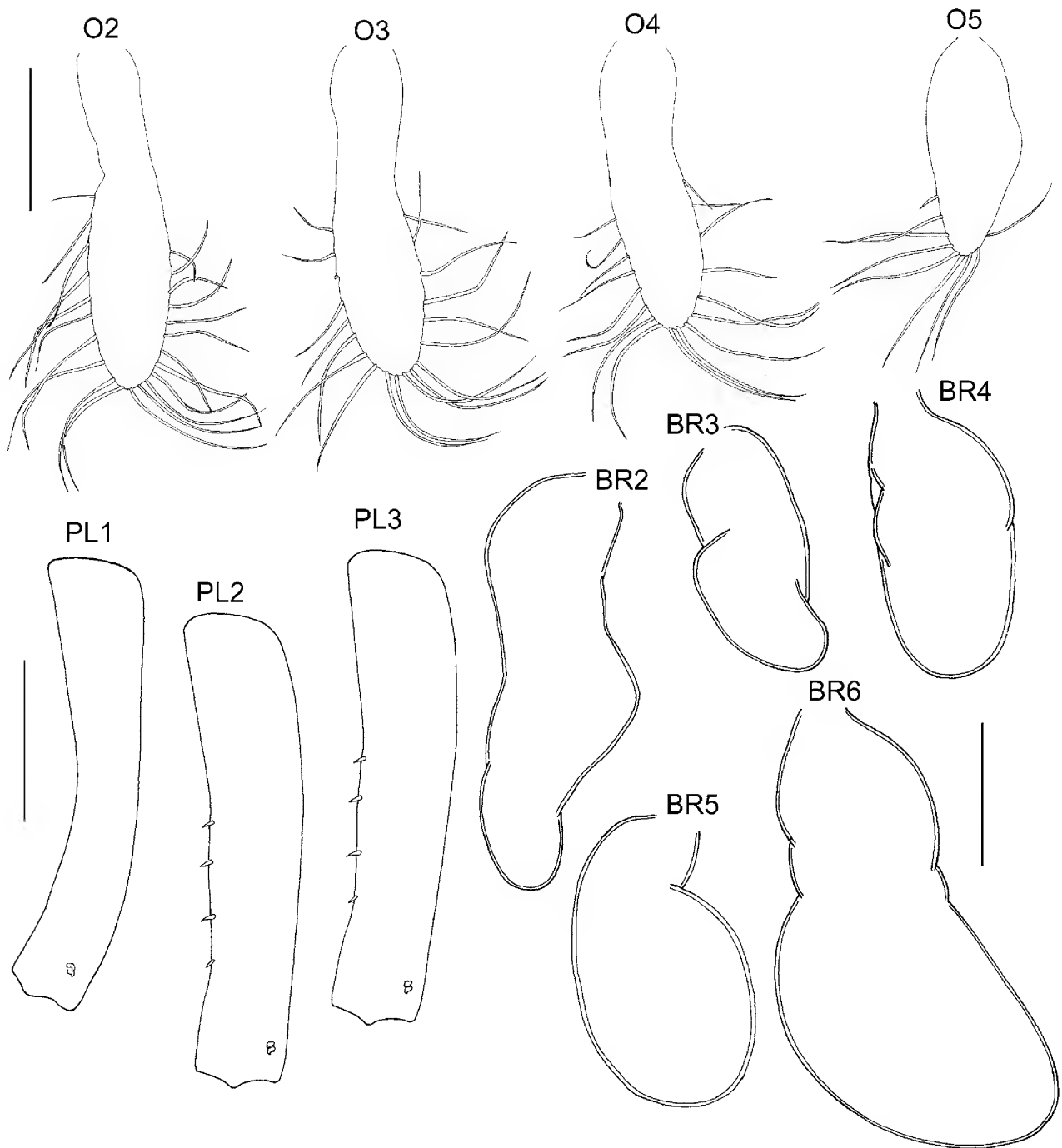


Fig. 26. *Platorchestia platensis* (Krøyer, 1845), paralectotype female, 7.8 mm, PL1–3, ZMUC CRU 7803. Scales for PL1–3: 0.3 mm; BR2–6 and O2–5: 0.5 mm.

***Protorchestia* Bousfield, 1982**

Protorchestia Bousfield, 1982: 7; Richardson, 1996: 580 (key).

Type species. *Orchestia nitida* Dana, 1852.

Diagnosis. Antenna 2 geniculate and not sexually dimorphic. Mandible left lacinia mobilis 5-dentate. Maxillipedal palp dactylus present, distinct. Gnathopod 2 subchelate; narrow or slightly expanded; propodus palm posterodistal corner without protuberance. Pereopods 3–7 simplidactylate. Pereopod 4 carpus similar in length to pereopod 3 carpus. Pereopods 6–7 not sexually dimorphic. Pereopod 7 basis lateral sulcus present, slightly pronounced. Gills simple, sac-like and similar in size. Oostegites 2–5 setae curl-tipped. Pleopods all well developed. Uropods 1–2 outer rami without marginal robust setae. Telson as long as or longer than broad without robust setae or with 2–5 robust setae per lobe.

Species composition. *Protorchestia* contains four species: *P. campbelliana* (Bousfield, 1964); *P. ceduna* n.sp., *P. lakei* Richardson, 1996; and *P. nitida* (Dana, 1852).

***Protorchestia ceduna* n.sp.**

Figs 27–29

Type material. HOLOTYPE: male 18.1 mm, AM P69066 (stubs J028–J032, J034–J035). PARATYPES: 1 female ovigerous, 10.2 mm AM P69067 (2 slides, stub J033, SEM micrographs); 2 males and 6 ovigerous females, AM P69068; male, 10.9 mm, AM P69069 (slide), small mangrove north of town, Ceduna, Eyre Peninsula, South Australia (32°8.87'S 133°40.24'E), small mangrove area with stony substrate, C. Serejo & J.K. Lowry, 19 Oct. 2003, SA 156.

Additional material examined. *Victoria*: 1 male and 3 females, AM P69063, boat ramp with man-made rocky shore, Port Albert (38°40.23'S 146°41.86'E), among rocks, C. Serejo & J.K. Lowry, 10 Oct. 2003, VIC 124.

South Australia: 7 males and 7 females, AM P69064, North Beach, Wallaroo (33°54.51'S 137°37.77'E), broad flat beach with hard packed grey sand with a broad band of dead seagrass (*Zostera*) and large patches of beach rock, C. Serejo & J.K. Lowry, 16 Oct. 2003, SA 149; 1 male, AM P69065, mangroves near boat ramp, Franklin Harbour, Cowell (33°41.26'S 136°55.65'E), thick mangrove (similar to *Avicennia*) with rocks and logs on muddy substrate, C. Serejo & J.K. Lowry, 17 Oct. 2003, SA 150; 2 males and 1 female, Rio Rego?, sheltered beach, Baird Bay, Eyre Peninsula (33°6.43'S 134°16.63'E), stones on a very protected beach, C. Serejo & J.K. Lowry, 18 Oct. 2003, SA 154.

Type material of *Protorchestia lakei* Richardson, 1996. Holotype female 7.7 mm, AM P45574. Paratype male, 9.2 mm, AM P 45575, northeast slope of Maatsuyker Island, Tasmania (on sea bird rookery between 10–80 m above sea level).

Etymology. This species is named for the town of Ceduna, near the type locality.

Diagnosis. Maxillipedal palp article 4 distinct and small, 1/5 of article 3. Lower lip with distolateral setal tuft. Uropod 3 ramus with or without setae. Oostegites 2–4 moderately setose, with 26, 35 and 32 setae respectively. Telson about 1.5× longer than wide.

Description

Holotype male, 18.1 mm. Eye medium, 1/5–1/4 head length. Antenna 1 elongate, from midpoint to end of peduncle article 5 of antenna 2, flagellum with 8 articles. Antenna 2 shorter than head and first 3 pereonites, peduncular articles narrow and with sparse, small robust setae; flagellum with 16 articles. Lower lip with distolateral setal tuft. Mandible left lacinia mobilis 5-dentate. Maxillipedal palp, article 2 without distomedial lobe, article 4 distinct and small, 1/5 of article 3.

Gnathopod 1 sexually dimorphic; subchelate; posterior margin of merus, carpus and propodus with rugose lobe; propodus subtriangular; palm transverse; dactylus shorter than palm, simplidactylate. Gnathopod 2 sexually dimorphic; subchelate; merus without medial lobe; carpus triangular, reduced, enclosed by merus and propodus; palm acute, smooth, posterodistal corner without protuberance; dactylus subequal in length to palm, attenuated distally. Coxae 2–4 as wide as deep. Pereopods 3–7 simplidactylate; dactylus without row or patch of dorsal short setae. Pereopod 4 subequal or slightly shorter than pereopod 3. Pereopod 4 dactylus similar to pereopod 3 dactylus. Pereopod 5 propodus distinctly longer than carpus. Pereopod 6 not sexually dimorphic; shorter than pereopod 7; coxa posterior lobe anterodistal corner rounded, with 1–2 marginal setae, posterior margin oblique to ventral margin, outer surface with ridge; carpus slender. Pereopod 7 basis posterodistal lobe absent; distal articles slender. Coxal gills simple or slightly lobate. Pereopods 3–5 gills subequal in size to gills 2 and 6.

Pleopods 1–3 well developed and biramous. Pleopods 1–3 peduncle without marginal setae. Epimeron 2 subequal in length to epimeron 3. Epimeron 3 posterior and ventral margins smooth, without setae, posteroventral corner with small subacute spine. Uropod 1 peduncle with 4–6 robust setae; distolateral robust seta present, large, about 1/3 to 1/2 length of outer ramus; inner ramus longer than outer ramus; inner ramus with 3 marginal robust setae; outer ramus without robust setae. Uropod 2 peduncle with 4 robust setae in two rows; inner ramus subequal in length to outer ramus; inner ramus with 3 marginal robust setae; outer ramus with marginal robust setae or without marginal robust setae; outer ramus with 1–2 marginal robust setae. Uropod 3 peduncle with 3 robust setae; ramus shorter than peduncle, triangular, narrowing distally, with 0–1 marginal seta, and 4 to 5 apical setae. Telson about 1.5× longer than wide; apically incised; with 2 apical robust setae per lobe; dorsal midline entire.

Female (sexually dimorphic characters), 10.2 mm. Antennae 1 with 6 articles. Antenna 2 with 13 articles. Gnathopod 1 propodus subrectangular; dactylus subequal in length to palm. Gnathopod 2 mitten-shaped; basis narrow, 3.4× longer than wide; posterior margin of merus, carpus and propodus with rugose lobe; palm obtuse; dactylus shorter than palm. Oostegites longer than wide; setae with curl-tips. Oostegites 2–4 moderately setose, with 26, 35 and 32 setae respectively. Uropod 3 peduncle with 0–1 robust setae.

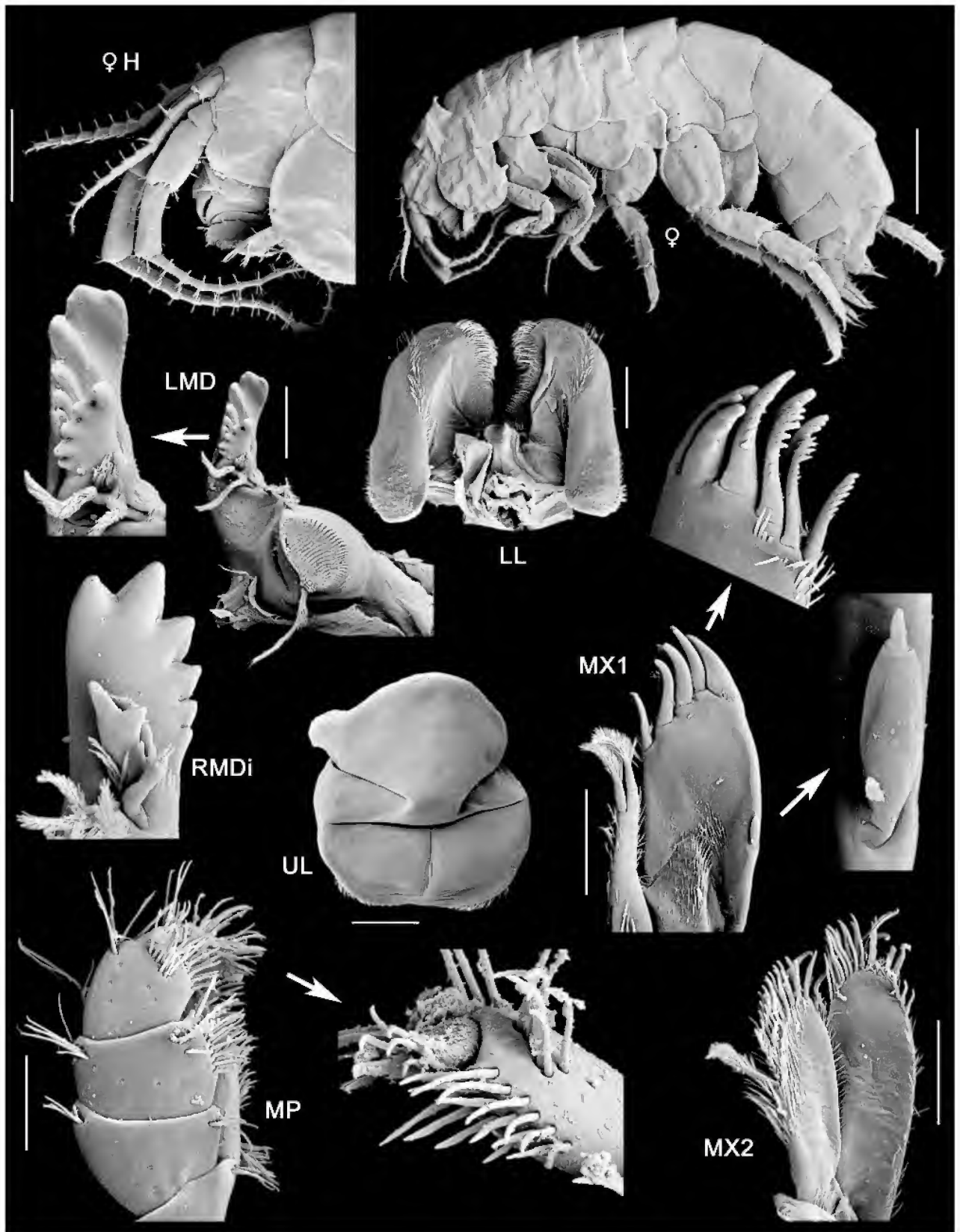


Fig. 27. *Protorchestia ceduna* n.sp., paratype female, 10.2 mm, habitus and H, AM P69067, Ceduna, South Australia; holotype male, 18.1 mm, other parts, AM P69066, Port Albert, Victoria. Scales for habitus: 1 mm; H: 0.5 mm; remainder: 0.1 mm.

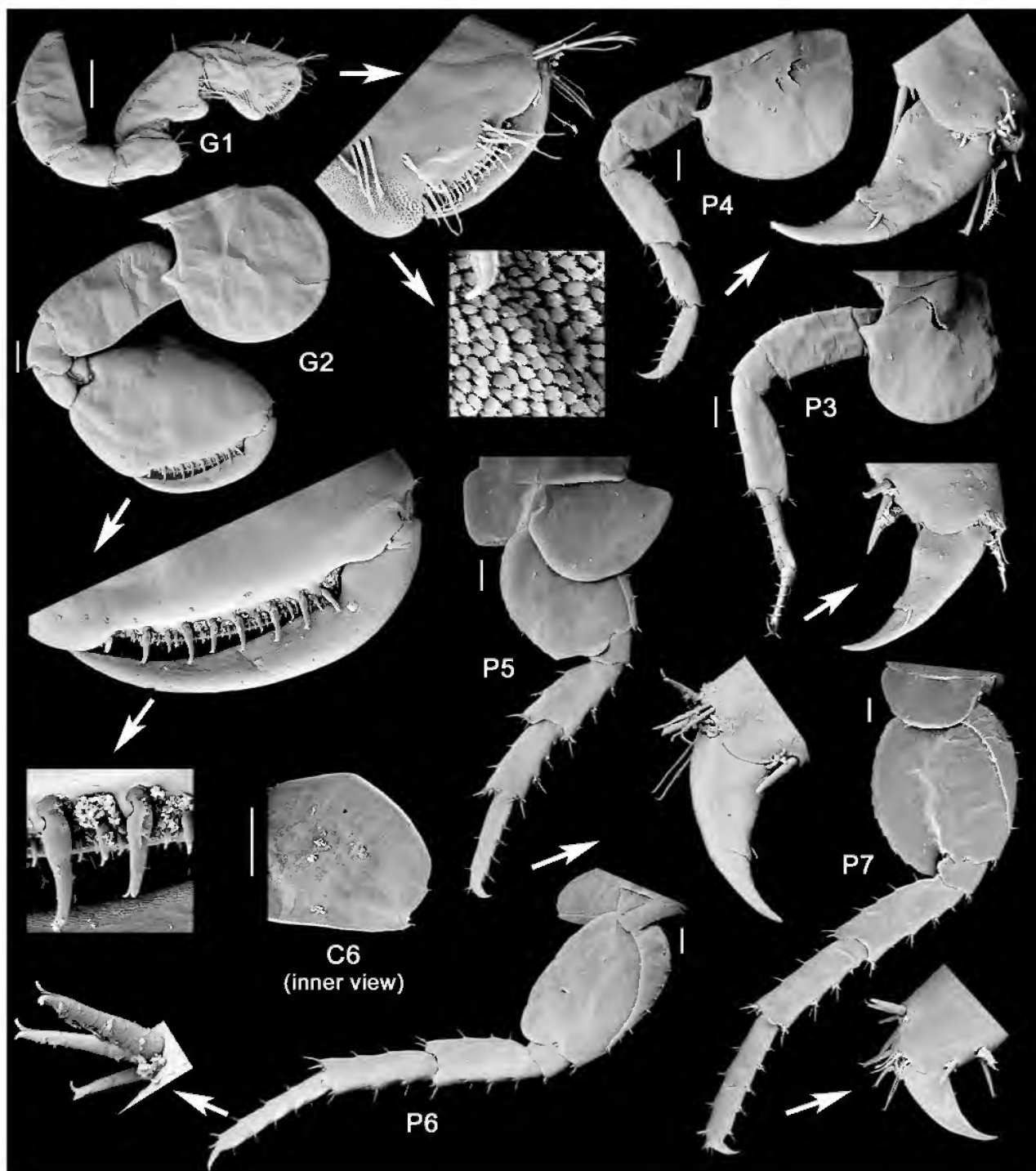


Fig. 28. *Protorchestia ceduna* n.sp., holotype male, 18.1 mm AM P69066, Port Albert, Victoria. Scales represent 0.2 mm.

Habitat. Estuarine zones and marshes.

Remarks. *Protorchestia ceduna* n.sp. is similar to *P. lakei*, species endemic to Tasmania northeast slope of Maatsuyker Island, in presenting a lower lip with distolateral setal tuft, general aspects of male and female gnathopods 1–2, and oostegites 2–4 with less than 36 marginal setae. Richardson (1996) described oostegite 2 bearing 24 setae and oostegites 3–4 bearing 20 and 24 setae respectively for *P. lakei*. The oostegites in the observed material have 26, 35 and 32 setae

respectively, never surpassing 50 setae as seen in *P. nitida* and *P. campbelliana*. Also, a clear transversal ridge on coxa 6, 1–4 facial minute setae on the peduncle of pleopods 1–3, and posterior margin of propodus of pereopods 3–5 having 1–2 pairs of robust setae were observed. Richardson (1996) did not mention the coxa 6 ridge, described only pleopod peduncle 1 with setae, and noted that pereopod 5 lacked posterior setae but did not describe them for pereopods 3–4. Re-examination of the type material of *P. lakei* confirmed the presence of these character states.

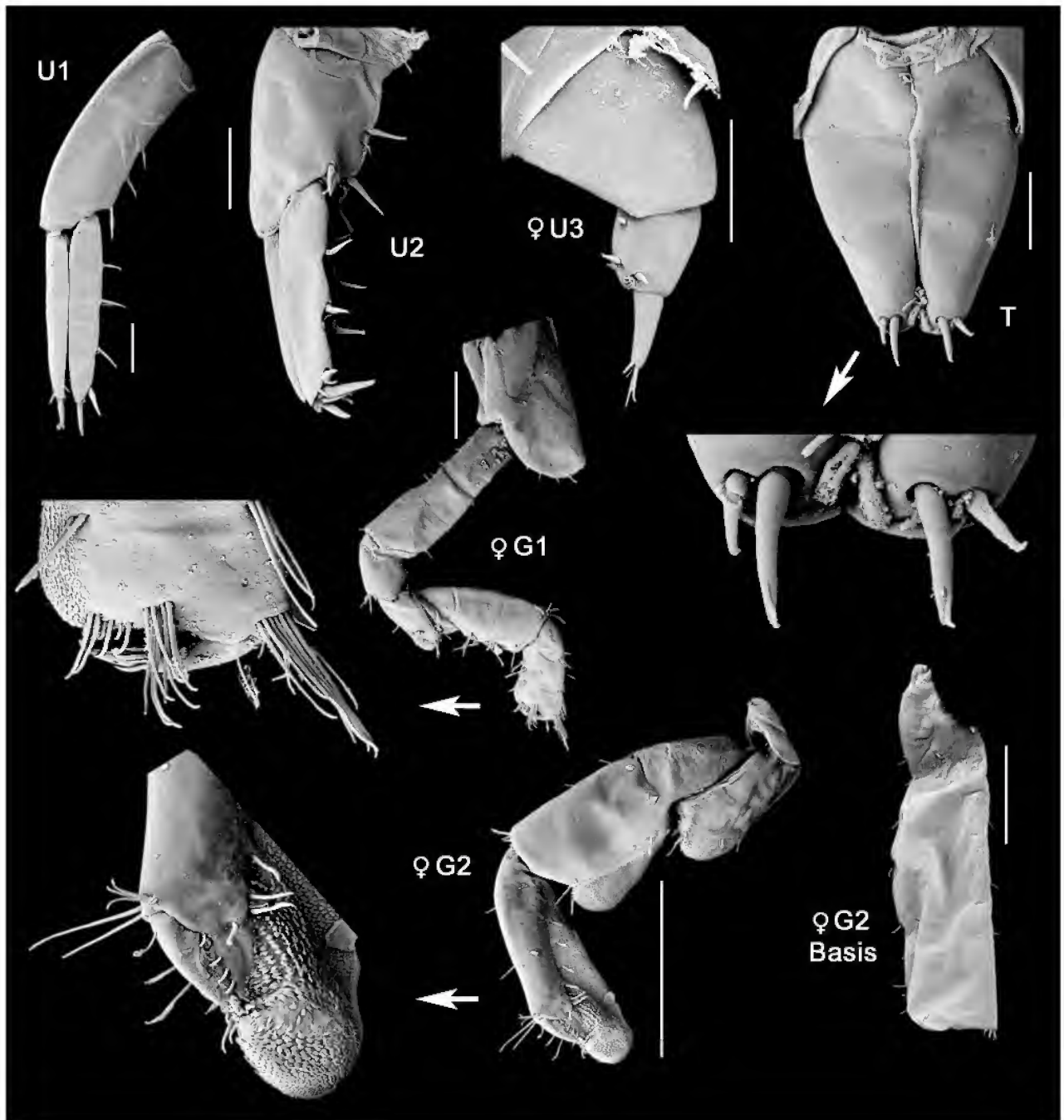


Fig. 29. *Protorchestia ceduna* n.sp., holotype male, 18.1 mm, U1–2 and T, AM P69066, Port Albert, Victoria; female, 10.2 mm, G1–2, AM P69067, Ceduna, South Australia. Scales represent 0.2 mm.

The more intriguing variation occurs on uropods 2 outer ramus and ramus of uropod 3, which generally lack robust setae. This state is found in most specimens herein observed (males and females) varying in size from 7.2 to 11.7 mm. However, in some larger males (16.6 to 18.1 mm), and even a smaller female (9.8 mm), the uropod 2 outer ramus and/or uropod 3 ramus had 1 or rarely 2 robust setae. Furthermore, in a female and a large male (16.6 mm) the left uropod 3 had a robust seta and the right one had none, showing the variation in a single individual. Richardson's 1996 description for *P.*

lakei stated that the outer ramus of uropod 2 and ramus of uropod 3 lack marginal robust setae and variation in these structures in the type material was not observed.

Distribution. *Victoria:* Port Albert. *South Australia:* North Beach, Wallaroo; Franklin Harbour, Cowell; sheltered beach, Baird Bay, Eyre Peninsula; Ceduna, Eyre Peninsula.

Transorchestia* Bousfield, 1982Transorchestia* Bousfield, 1982: 19.**Type species.** *Orchestia chilensis* Milne-Edwards, 1840.

Diagnosis. Antenna 2 not geniculate, sexually dimorphic. Mandible left lacinia mobilis 4-dentate. Maxillipedal palp dactylus present, reduced. Gnathopod 2 subchelate; basis slightly or strongly expanded; propodus palm posterodistal corner without protuberance. Pereopods 3–7 cuspidactylate. Pereopod 4 carpus significantly shorter than carpus of pereopod 3. Pereopods 6–7 sexually dimorphic. Pereopod 7 basis lateral sulcus present, slightly pronounced. Gills lobate and/or convoluted; gills 3–5 smaller than gills 2 and 6. Oostegites 2–5 setae curl-tipped. Pleopods all well developed. Uropods 1–2 outer rami with marginal robust setae. Telson longer than broad with more than 10 robust setae per lobe.

Species composition. *Transorchestia* contains 7 species: *T. ?bollonsi* (Chilton, 1909); *T. chilensis* (Milne Edwards, 1840); *T. enigmatica* (Bousfield & Carlton, 1967); *T. gracilis* (Chilton, 1920); *T. marlo* n.sp.; *T. miranda* (Chilton, 1916); and *T. serrulata* (Dana, 1852).

Remarks. Hurley (1957) considered that *T. chilensis* occurred in New Zealand and included *Orchestia serrulata* Dana, 1852, also described from New Zealand, as its junior synonym. Bousfield (1982) redescribed *T. chilensis* based on material from Chile and stated that Hurley's material from New Zealand was not *T. chilensis*. Based on the opinion of Bousfield (1982) and our own assessment of Hurley's (1957) description we reject *T. chilensis* from New Zealand and replace it with the next available name, *Transorchestia serrulata* (Dana, 1852). Hurley designated as hypotypes: slides No. 19, male; female, Quail Island, Lyttelton, 10 October 1903, in the Chilton collection, Canterbury Museum. We here designate the male as a neotype of *Transorchestia serrulata* (Dana, 1852).

***Transorchestia marlo* n.sp.**

Figs 30–33

Type material. HOLOTYPE: 1 male, 18.6 mm, AM P69136 (slide, stubs J071–J074, J075 [part, G1], J077–J079, SEM micrographs), near mouth of Separation Creek, Victoria (38°37.96'S 143°53.78'E), freshwater creek with stony bottom, under stones (freshwater), C. Serejo & J.K. Lowry, 12 Oct. 2003, VIC 131. PARATYPES: 1 male, 15.5 mm (habitus), AM P69137 (stub J081); 1 juvenile male, 13.1 mm, AM P69138 (stub J075 [part, G2]); 1 female 13.6 mm, AM P69139 (slide, stub J076, J080, SEM micrographs); 73 specimens, AM P69140, mouth of Erskine River just beside the swinging bridge, Lorne, Victoria (38°32.1'S 143°58.59'E), limestone rocks in small pools (freshwater), C. Serejo & J.K. Lowry, 12 Oct. 2003, VIC 129; 1 male AM P69143, VIC 131.

Type locality. Near mouth of Separation Creek, Victoria (38°37.96'S 143°53.78'E), freshwater creek with stony bottom, under stones (freshwater).

Additional material examined. *Victoria*: 10 males and 22 females, AM P69141, large marsh near Snowy River Boat Club, Marlo (37°47.88'S 148°31.6'E), beach-hoppers sheltering in dead logs in marsh on the margin of the Snowy River (freshwater), C. Serejo & J.K. Lowry, 9 Oct. 2003, VIC 121.

Western Australia: 3 males and 10 females, AM P69142, Wilson Inlet, Denmark River mouth (34°58.28'S 117°22.04'E), soil bank on edge of river just where it opens into the inlet, C. Serejo & J.K. Lowry, 22 Oct. 2003, WA 757.

Etymology. This species is named for the town of Marlo, near the site of the first collections of the species.

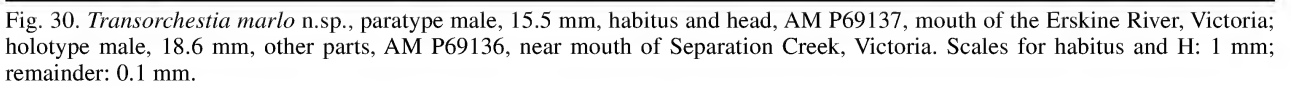
Diagnosis. Gnathopod 2, basis anteriorly serrate, palm very concave posterior to a strong distal hinge tooth; dactylus sinuous, subequal in length to palm, not attenuated distally. Male pereopods 6–7 article 5 about 2.3× longer than wide. Basis of female gnathopod 2 about 1.7× as long as wide. Oostegites 2–5 with curl-tipped setae. Oostegite 2 with 37 setae distributed unevenly.

Description

Male, 18.6 mm. Antenna 1 short, rarely longer than peduncle article 4 of antenna 2, flagellum with 7 articles. Antenna 2 shorter than head and first 3 pereonites, peduncular articles expanded, with sparse, small robust setae; article 5 subequal than article 4; flagellum with 20 articles. Epistome of upper lip without robust setae. Lower lip distolateral setal tuft absent. Mandible left lacinia mobilis 4-dentate. Maxillipedal palp article 2 without mediolateral lobe, article 4 present, reduced.

Gnathopod 1 sexually dimorphic; subchelate; posterior margin of merus, carpus and propodus with rugose lobe; propodus subtriangular; palm transverse; dactylus shorter than palm, simplidactylate. Gnathopod 2 sexually dimorphic; subchelate; basis anteriorly serrate; merus without medial lobe; carpus posterior margin not distally concave; palm concave posterior to a strong distal hinge tooth, posterodistal corner without protuberance; dactylus subequal in length to palm, not attenuated distally. Coxae 2–4 as wide as deep. Pereopods 3–7 cuspidactylate; dactylus without row or patch of dorsal short setae. Pereopod 4 dactylus thickened and pinched posteriorly, different to pereopod 3 dactylus. Pereopod 5 propodus subequal to or shorter than carpus. Pereopod 6 sexually dimorphic; shorter than pereopod 7; coxa posterior lobe anterodistal corner subquadrate, with 12 marginal setae, posterior margin perpendicular to ventral margin, outer surface with ridge; carpus expanded, about 2.3× longer than wide. Pereopod 7 sexually dimorphic; basis without lateral sulcus, posterodistal lobe present; distal articles expanded; carpus subrectangular, about 2.3× longer than wide. Coxal gills convoluted or simple. Pereopods 3–5 gills smaller than gills 2 and 6.

Pleopods 1–3 well developed, biramous. Pleopod 1 peduncle without marginal setae. Pleopod 2–3 peduncle with few marginal robust setae. Epimeron 2 subequal in length to epimeron 3. Epimera 1–3 posterior margin minutely serrate, posteroventral corner acutely produced, ventral margin without robust setae. Uropod 1 peduncle with more than 6 robust setae; distolateral robust seta absent; inner ramus subequal in length to outer ramus, with 3 marginal robust setae; outer ramus with 5 marginal robust setae. Uropod



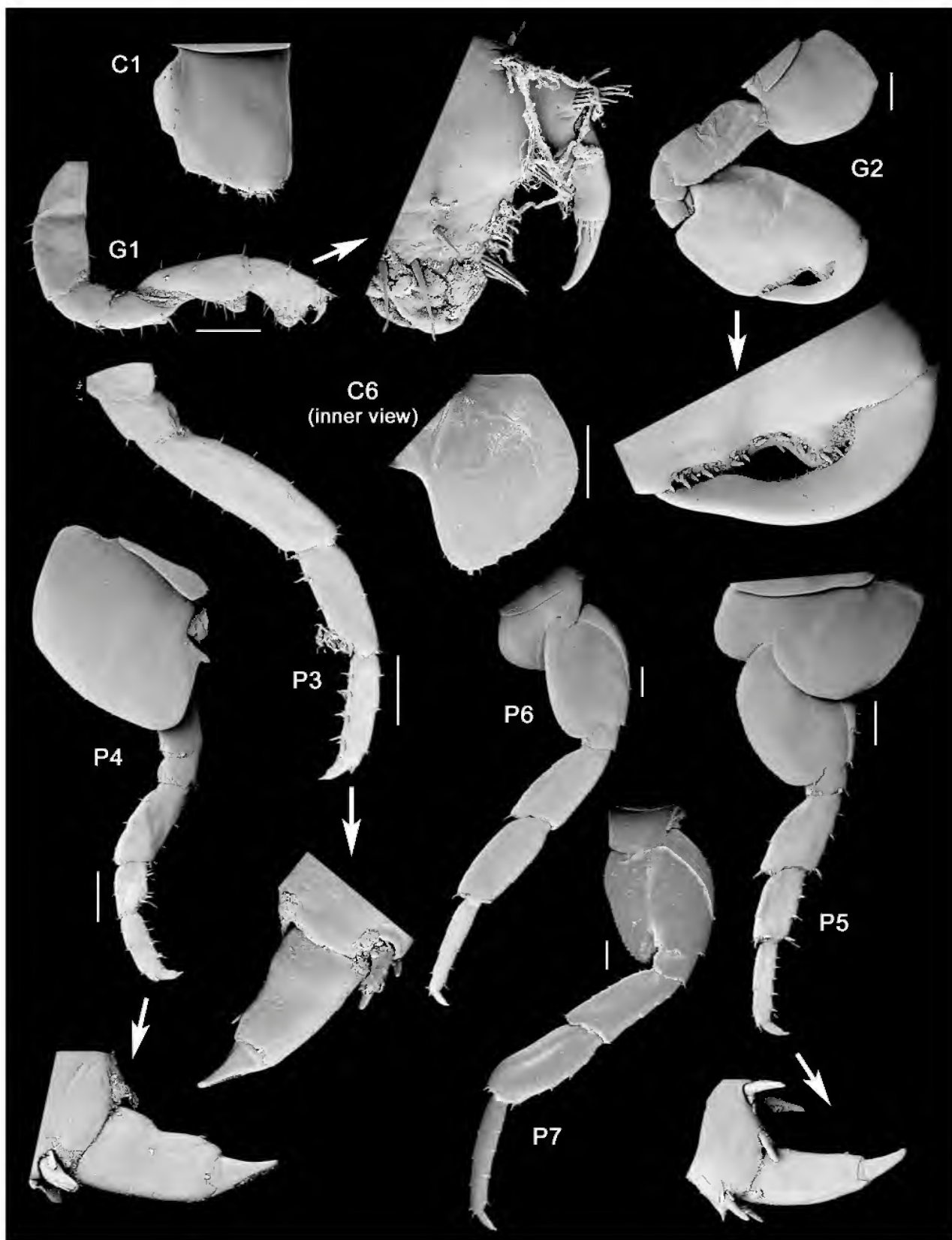


Fig. 31. *Transorchestia marlo* n.sp., holotype male, 18.6 mm, AM P69136, near mouth of Separation Creek, Victoria. Scales represent 0.5 mm.

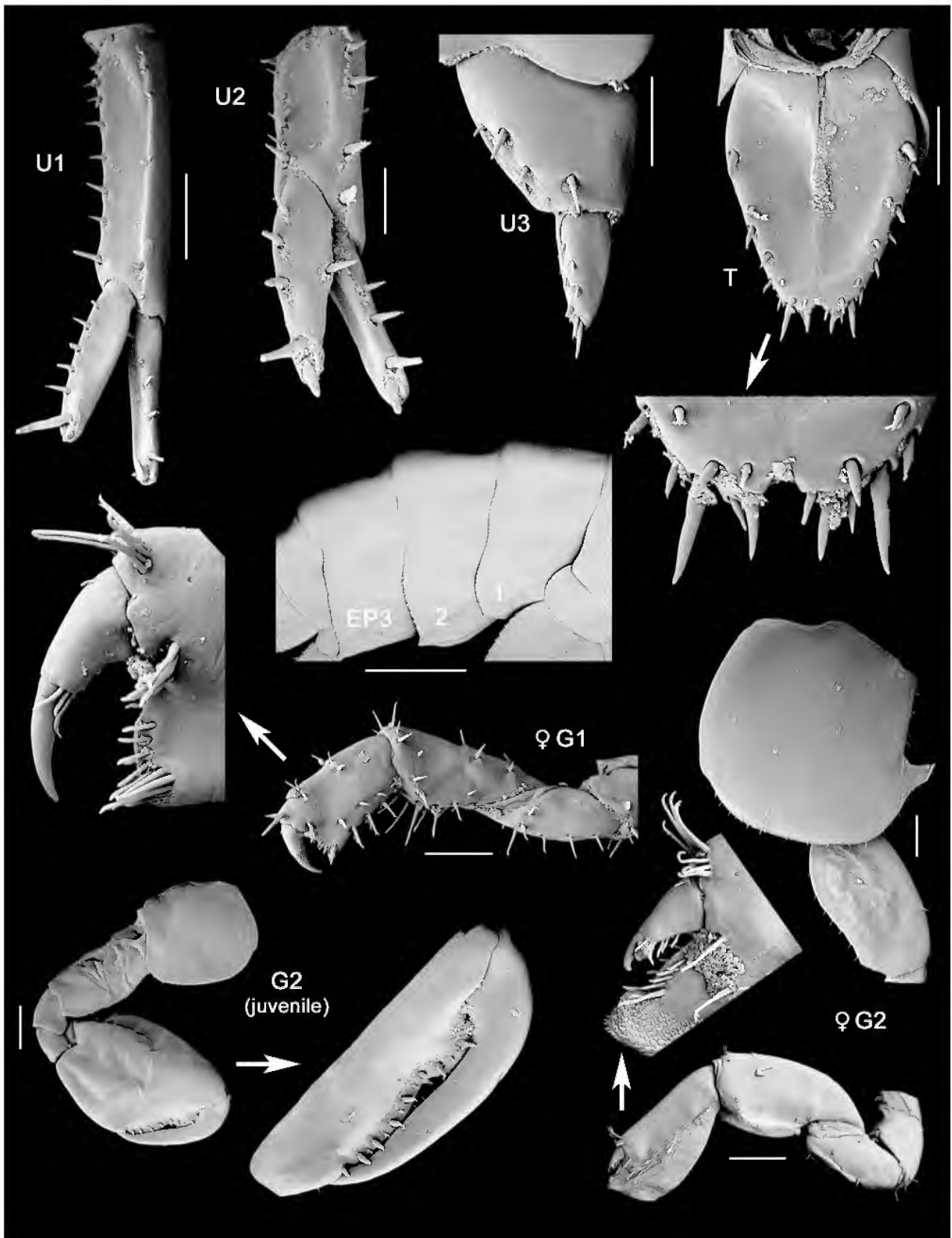


Fig. 32. *Transorchestia marlo* n.sp., holotype male, 18.6 mm, U1–3, T, AM P69136, near mouth of Separation Creek, Victoria.; paratype female, 13.6 mm, G1–2, AM P69139; paratype juvenile male, 13.1 mm, G2, AM P69138, mouth of the Erskine River, Victoria. Scale for EP3: 1 mm; remainder: 0.2 mm.

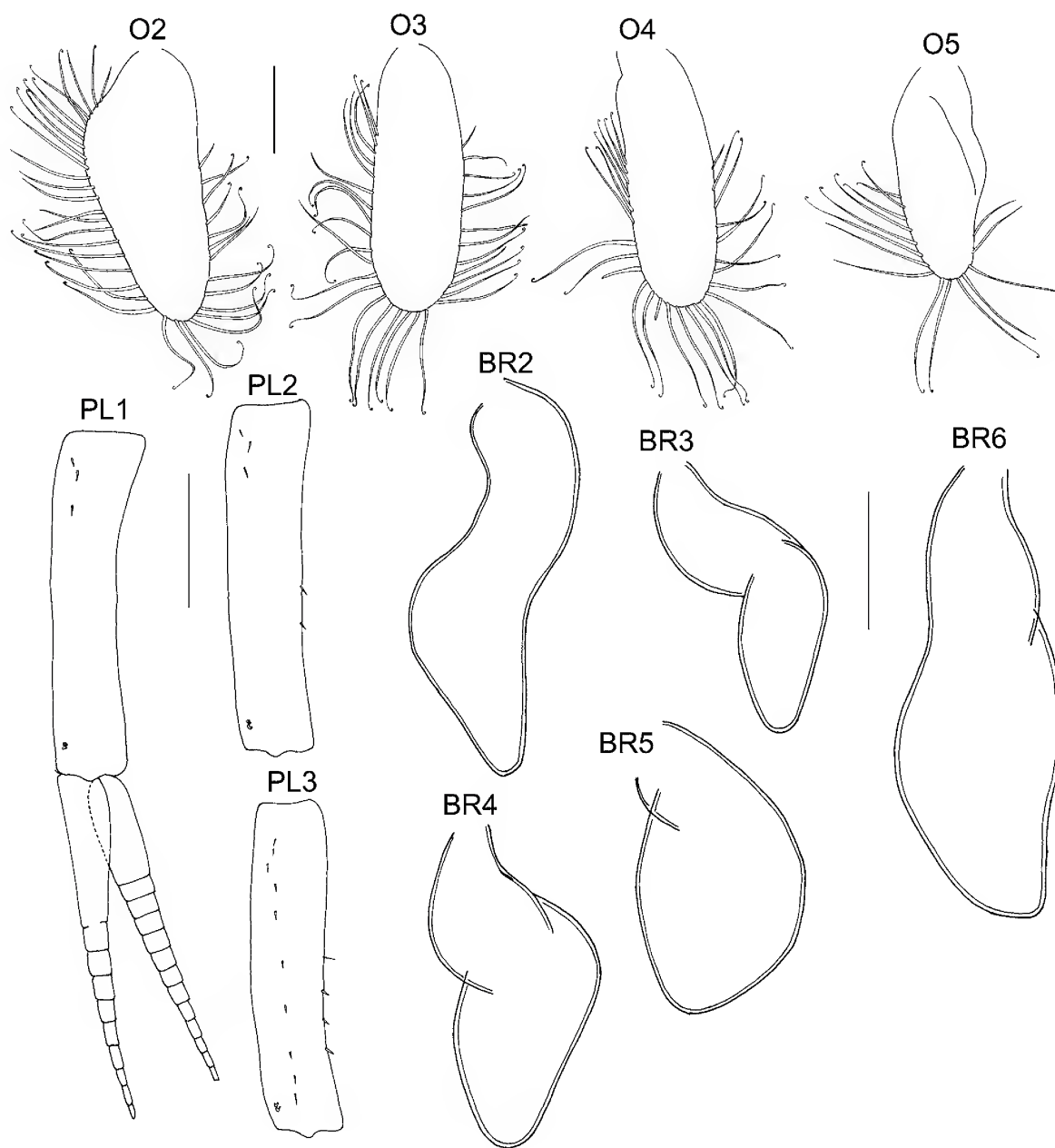


Fig. 33. *Transorchestia marlo* n.sp., paratype female, 13.6 mm, O2–5, AM P69139, mouth of the Erskine River, Victoria; holotype male, 18.6 mm, PL1–3 and BR2–6, AM P69136, near mouth of Separation Creek, Victoria. Scales represent 0.5 mm.

2 peduncle with 10 robust setae in two rows; inner ramus subequal in length to outer ramus, with 2 marginal robust setae; outer ramus with 3 marginal robust setae. Uropod 3 peduncle with 6 robust setae; ramus shorter than peduncle; oval to spatula-shape, broad distally; ramus with 5 marginal setae and 3 apical setae. Telson longer than broad; apically incised; dorsal midline halfway; with marginal and apical robust setae; more than 10 robust setae per lobe.

Female (sexually dimorphic characters), 13.6 mm. Antenna 2 peduncular articles narrow. Gnathopod 1 subchelate, posterior margin of merus, carpus and propodus without

rugose lobe; propodus subrectangular; dactylus subequal in length to palm. Gnathopod 2 mitten-shaped; basis expanded proximally, about 1.7× longer than wide; posterior margin of merus, carpus and propodus with rugose lobe; dactylus shorter than palm. Pereopod 6 carpus slender. Pereopod 7 distal articles slender. Oostegites longer than wide; setae with curl-tips. Oostegites 2–4 moderately setose (between 37 to 15 setae respectively).

Habitat. Found on mouth or on margin of rivers hidden under logs, roots and other organic matter.

Remarks. *Transorchestia marlo* n.sp. is part of the *T. chiliensis* (Milne-Edwards, 1840) complex because the palm of gnathopod 2 is concave posterior to a strong distal hinge tooth and pereopod 7 carpus is incrassate (Bousfield, 1982). *Transorchestia marlo* n.sp. differs from *T. chiliensis* from Puerto Robalo, Chile (Bousfield, 1982) as follows: the basis of male gnathopod 2 is distinctly serrate (versus not serrate); the palm and dactylus of gnathopod 2 are more strongly sinuous; the carpus of pereopod 7 is not so enlarged, and the basis of female gnathopod 2 is about 1.5× as long as wide (not 2× as long as wide). The Australian species is closer to Hurley's (1957) material from New Zealand (considered here as *T. serrulata* Dana, 1852) in having a similar shape of gnathopod 2 (serrate basis and strongly sinuous palm and dactylus), but some differences were observed between these two taxa as follows: male pereopods 6–7 article 5 longer and less enlarged, about 2.3× longer than wide (versus 1.5× longer than wide); oostegites 2–5 are curl-tipped (illustrated as not curl-tipped, but could have been overlooked by the author); oostegite 2 with 37 setae distributed unevenly, with about 12–13 setae on one side and 24–25 setae on other side (versus about 33 setae distributed evenly [16–17 setae for each side]). The males figured here (Fig. 30, habitus = 15.5 mm; Fig. 31, P6–7 = 18.6 mm) are similar in size or larger from the male figured by Hurley (1957) (15.75 mm), which eliminates the age dependent factor that influences characters such as shape of gnathopod 2 and stoutness of pereopod 6–7. The juvenile form of gnathopod 2 was observed in a 13.1 mm male (Fig. 32).

Distribution. *Victoria*: Marlo; Erskine River; Separation Creek. *Western Australia*: Wilson Inlet, Denmark River mouth.

Discussion

This study is mainly based on the results of ANTS 1, a project that collected specimens from Victoria and South Australia to Exmouth Gulf, Western Australia. The lack of knowledge about coastal talitrids in this area was confirmed, since of the eight species documented, seven are new to science. The most common species found were *Notorchestia australis* and *N. lobata*. In South Australia, *N. australis* appeared in 17 of the 21 sites collected, although this species was not found in Western Australia. On the other hand, *Notorchestia lobata* has a wider distribution, found from South Australia to Jurien Beach in Western Australia. The other species presented a more punctuated distribution, with three of them restricted to Western Australia—*A. occidentalis*; *N. naturaliste* and *P. paraplatus*.

Australia is a large and long-time isolated continent, which results in high rates of endemism in many zoological groups (Hutchings & Glasby, 1991; Poore, 2002; Lowry & Stoddart, 2003). All eight species treated in this study are endemic to Australia.

The second part of this study, named as ANTS 2, was done with collections from tropical eastern Australia, including Queensland and northern New South Wales. Species of *Platorchestia*, *Chroestia*, *Talorchestia* s.str. and a new palustral (marsh-hopper) form were found and will be described in a subsequent paper.

ACKNOWLEDGMENTS. The first author thanks CAPES (Fundação Coordenação de Aperfeiçoamento de Pessoal de Nível Superior) for financial support as a post-doctoral fellowship (0597–03–1). I also want to thank the whole Marine Invertebrate team for the nice and warm reception in the one year study at the Australian Museum. We thank the Australian Museum who provided a Visiting Fellowship grant to collect talitrids along the Australian coast. Thanks also to John and Robin Bradbury (South Australian Museum) who gave us a place to stay in Adelaide and helped in collecting material. In Perth, Diana Jones (Western Australia Museum) gave us a place to stay and helped us collect material. Gary and Linsey Poore (Museum Victoria) gave us a place to stay in Melbourne. We want to thank also Jorgen Olesen (Zoologiske Museum, Copenhagen) for the loan of *P. platensis* material, Roger Springthorpe for composing many of the plates used, and Sue Lindsey for making the SEM photos.

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Manuscript submitted 23 June 2006, revised 1 August 2007, and accepted 1 August 2007.

Associate Editor: G.D.F. Wilson.

Talcopsaltriini, a New Tribe for a New Genus and Species of Australian Cicada (Hemiptera: Cicadoidea: Cicadidae)

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ABSTRACT. A new tribe, Talcopsaltriini, subfamily Cicadinae, is described to accommodate *Talcopsaltria olivei*, n.gen., n.sp. a species recorded from Cape York Peninsula, Queensland. Relationships of the Talcopsaltriini are discussed and comparisons made with allied tribes. A modified key to Australian tribes of the subfamily Cicadinae is provided. The terms *anterior* and *posterior cranial depressions* are introduced for two structures on the head previously unnamed.

MOULDS, M.S., 2008. Talcopsaltriini, a new tribe for a new genus and species of Australian cicada (Hemiptera: Cicadoidea: Cicadidae). *Records of the Australian Museum* 60(3): 207–214.

A new Australian cicada from north-eastern Queensland has proved to be so different from other known species that it warrants not only a new genus but also a new tribe. *Talcopsaltria olivei* n.gen., n.sp. is described and placed in a new tribe Talcopsaltriini, subfamily Cicadinae. This new tribe is compared with allied tribes.

The following abbreviations are used: AM, Australian Museum, Sydney; AE, collection of A. Ewart, Caloundra; JO, collection of J. Olive, Cairns; MSM, collection of M.S. Moulds, Kuranda; PH, collection of P. Hutchinson, Perth; QM, Queensland Museum, Brisbane.

Terminology

Terminology for morphological features follows that of Moulds (2005) for all structures except those of the timbal that follow Bennet-Clark (1997).

Two structures are named here for the first time; the *anterior* and *posterior cranial depressions*. These are external pitted depressions for internal musculature attachment of the retractor muscles of the mandibular

and maxillary stylets. The anterior cranial depressions are located one each posterolaterally of each lateral ocellus and are either single, shallow, somewhat circular depressions or clustered, multiple, irregularly-shaped depressions. The posterior cranial depressions are a little more posterolateral and are normally just visible against the anterior margin of the pronotum as single, nearly circular shallow depressions that in some species are very distinct.

Subfamily Cicadinae Latreille, 1802

Tribe Talcopsaltriini new tribe

In a recent paper (Moulds, 2005) I reviewed the tribes of Australian cicadas and provided keys to their identities. Using the key to the subfamily Cicadinae from that paper, the new tribe described here comes out as Platypleurini. It indeed has a number of attributes in common with the Platypleurini as follows: vertical compression of the body; pronotal collar moderately broad and even in width between the lateral angles; postclypeus broad in dorsal view giving the

head a blunt appearance (although not in *Koma* Distant, and to a lesser degree in *Sadaka* Distant); male abdomen stout, in length less than head and thorax together; male abdominal tergites 2 and 3 wider along their midlines than tergites 4–7; epimeral lobe reaching to operculum; primary spine of the fore femur prostrate; male genitalia with aedeagus tubular, simple.

There are, however, six notable differences that separate the new tribe from the Platyleurini: fore wing precostal area is not dilated; pronotal collar lateral margin is not dilated horizontally; male pygofer with a well developed distal shoulder; male uncus completely lacking of clasper development on either side of base of median lobe (Platyleurini show low swellings at the median lobe base); male timbal cover substantially reduced so that less than half the timbal cavity is covered (Platyleurini have the timbal covers reaching the metathorax); and reduction of the timbal cover is entirely lateral whereas in those platyleurine genera with reduced timbal covers (*Afzeliada* Boulard, *Brevisiana* Boulard, *Ioba* Distant, *Kongota* Distant, *Platyleura* Amyot & Serville, *Pycna* Amyot & Serville, *Sadaka* Distant, *Ugada* Distant and possibly a few others not examined) there is a vertical contraction of the timbal cover from the top of the timbal cavity and any lateral reduction is minimal. These differences suggest either a different origin for *Talcopsaltria* n.gen. from that of the Platyleurini, or a sister group relationship within the Platyleurini to all other platyleurine genera. The latter difference, that is timbal covers that reach to the top of the timbal cavity in *Talcopsaltria*, is considered particularly significant in showing that *Talcopsaltria* has a different origin [see discussion of timbal cover development in Moulds (2005: 413)] and I believe shows a distinction distant enough from the Platyleurini to warrant separate tribal status.

Within the Australian fauna there are similarities also with the Thophini and Cryptotympanini. While both have well developed timbal covers that close the timbal cavity, the Thophini have highly modified swollen timbal covers and associated abdominal modification while the Cryptotympanini have a significantly different thecal shape where the theca recurves basally through 180° or more. Australian Cicadinae tribes with minimal timbal cover development (covering less than half the timbal cavity) are the Jassopsaltriini, Burbungini and Tamasini. Unlike *Talcopsaltria* all three of these tribes have timbal covers that do not reach the top of the timbal cavity. Further, the Jassopsaltriini and Burbungini have the base of the theca shaped similarly to that of the Cryptotympanini and an epimeral lobe not reaching the operculum while the Tamasini

have differences that include a very different basal plate where the basal part of the basal plate is directed upwards and is nearly parallel with the thecal shaft.

There are no New Guinean or Indonesian cicadas with timbal covers that reach half way or less across the timbal cavity.

Type genus: *Talcopsaltria* n.gen. (type species *Talcopsaltria olivei* n.sp.)

Included genera: *Talcopsaltria* n.gen.

Diagnosis

Head with distance between supra-antennal plate and eye much greater than length of antennal plate. Postclypeus rounded in transverse cross-section; postclypeal ridges lacking transverse grooves towards distal ends. Fore wing pterostigma present; costa parallel-sided to node; veins C and R+Sc close together; vein RA+ aligned closely with subcosta (Sc) for its length. Hind wing with anal lobe broad and vein 3A curved at distal end, long, separated from wing margin. Meracanthus gradually tapering to a point, triangular or nearly so. Abdomen with epipleurites reflexed to ventral surface, epipleurites not kinked inwardly in a V-shape. Timbals extended below wing bases. Timbal covers flat, clearly not reaching metathorax, not reduced dorsally or ventrally so that the upper margin originates from the very top of timbal cavity and the lower margin extends from near auditory capsule. Male pygofer with upper lobe absent; distal shoulder well developed, lobe-like; pygofer basal lobe moderately developed. Uncus undivided and dominated by large median lobe that is digitate or basically tubular. Claspers entirely undeveloped, absent. Aedeagus with ventral rib completely fused with basal plate; theca with shaft gently curved more or less in an arc; pseudoparameres absent.

Distinguishing characters

Separated from other tribes by a combination of the following two characters: distance between supra-antennal plate and eye much greater than length of supra-antennal plate; hind wing 1st cubital cell at distal end shorter than that of 2nd cubital cell. Males are easily distinguished by a combination of the following two characters: a short abdomen that is less than the length of head and thorax together; small timbal covers that cover half or less of the timbal cavity and protrude forwards from the very top of the timbal cavity.

Key to Australian tribes of the subfamily Cicadinae

The new tribe Talcopsaltriini, keys out after couplet 3 of the key to Australian tribes of Moulds (2005: 429), as follows:

- 1 Head with vertex very wide so that the supra-antennal plate clearly reaches less than half way to eye 2
- Head with vertex of average width or narrow so that the supra-antennal plate reaches at least half way to eye 7
- 2 Epimeral lobe not reaching operculum Burbungini
- Epimeral lobe reaching operculum 3
- 3 Fore leg femoral primary spine lying flat, prostrate 4
- Fore leg femoral primary spine erect 5
- 4 Lateral margin of pronotal collar dilated horizontally; male timbal cover reaching, or almost reaching, metathorax Platypleurini
- Lateral margin of pronotal collar not dilated horizontally; male timbal cover only reaching about half way to metathorax Talcopsaltriini **n.tribe**
- 5 Male 6
- Female Cryptotympanini or Thophini
- 6 Timbal covers flat Cryptotympanini
- Timbal covers inflated, sac-like Thophini
- 7 Pronotal collar with a single mid-lateral tooth; male opercula (of Australian species) very long, covering some $\frac{2}{3}$ length of abdomen Dundubiini (subtribe Cosmopsaltriina)
- Pronotal collar with lateral margin smooth; male opercula very long, covering some $\frac{2}{3}$ length of abdomen 8
- 8 Head considerably less than width of pronotum; fore wing veins C and R+Sc widely separated Cyclochilini
- Head about as wide as pronotum; fore wing veins C and R+Sc abutted for their length 9
- 9 Lateral ocelli widely separated, the distance between them about equal to the distance between each lateral ocellus and eye Jassopsaltriini
- Lateral ocelli closely spaced, the distance between them considerably less than the distance between each lateral ocellus and eye Tamasini

Genus *Talcopsaltria* n.gen.

Figs 1–10

Type species: *Talcopsaltria olivei* n.sp.

Included species: *Talcopsaltria olivei* n.sp.

Etymology: Derived from the word *talc* and referring to the white fine “dusting” over the body, and the Greek *psaltria*, a female harpist and a traditional ending for many cicada generic names; feminine.

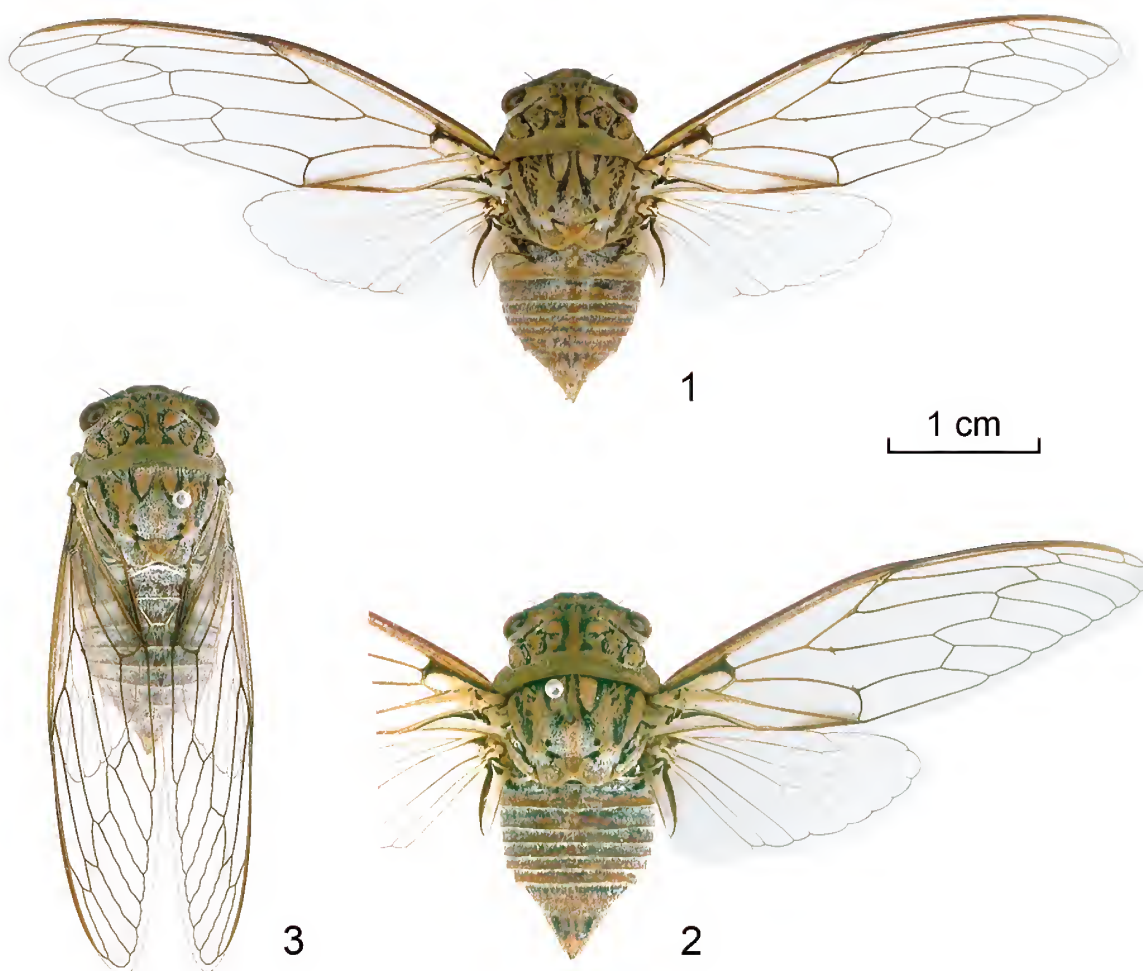
Diagnosis (Figs 1–10)

Body tending compressed vertically; extensively covered with a talc-like “dusting” of fine white pubescence mixed with a fine white, waxy exudation.

Head including eyes wider than mesonotum but clearly narrower than lateral angles of pronotal collar; postclypeus in lateral profile rounded between “top” and “sides”, midline clearly depressed.

Thorax. Pronotal collar width at dorsal midline moderately broad, but less than diameter of eyes; lateral margins weakly amplate, no mid lateral tooth but edged with many microscopic spine-like bristles. Cruciform elevation wider than long. Epimeral lobe reaching operculum. Metanotum entirely concealed at dorsal midline.

Wings (Figs 1–3, 7). Fore wings hyaline; infuscation overlaying distal end of vein CuP+1A and adjacent portion of 2A+3A; 8 apical cells; subapical cells absent; ulnar cell 3 angled to radial cell; vein CuA only weakly bowed so that cubital cell no larger than medial cell; veins M and CuA widely separated at basal cell making basal cell broad



Figs 1–3. *Talcopsaltria olivei* n.sp.: (1) holotype male, dorsal view; (2) paratype female, dorsal view; (3) paratype male, dorsal view with wings folded in resting position.

and tending to be rounded; vein CuA_1 divided by crossvein $m-cu$ so that proximal portion longest; wing outer margin developed for its total length, never reduced to be contiguous with ambient vein. Hind wings with 6 apical cells; no infuscation on ambient vein; width of 1st cubital cell at distal end shorter than that of 2nd cubital cell; anal lobe broad with vein 3A curved, long, separated from wing margin.

Legs. Fore leg femoral primary spine lying flat, prostrate. Meracanthus with spur slender, triangular.

Opercula (Fig. 10). Male opercula completely encapsulating meracanthus, covering tympanal cavity but not meeting.

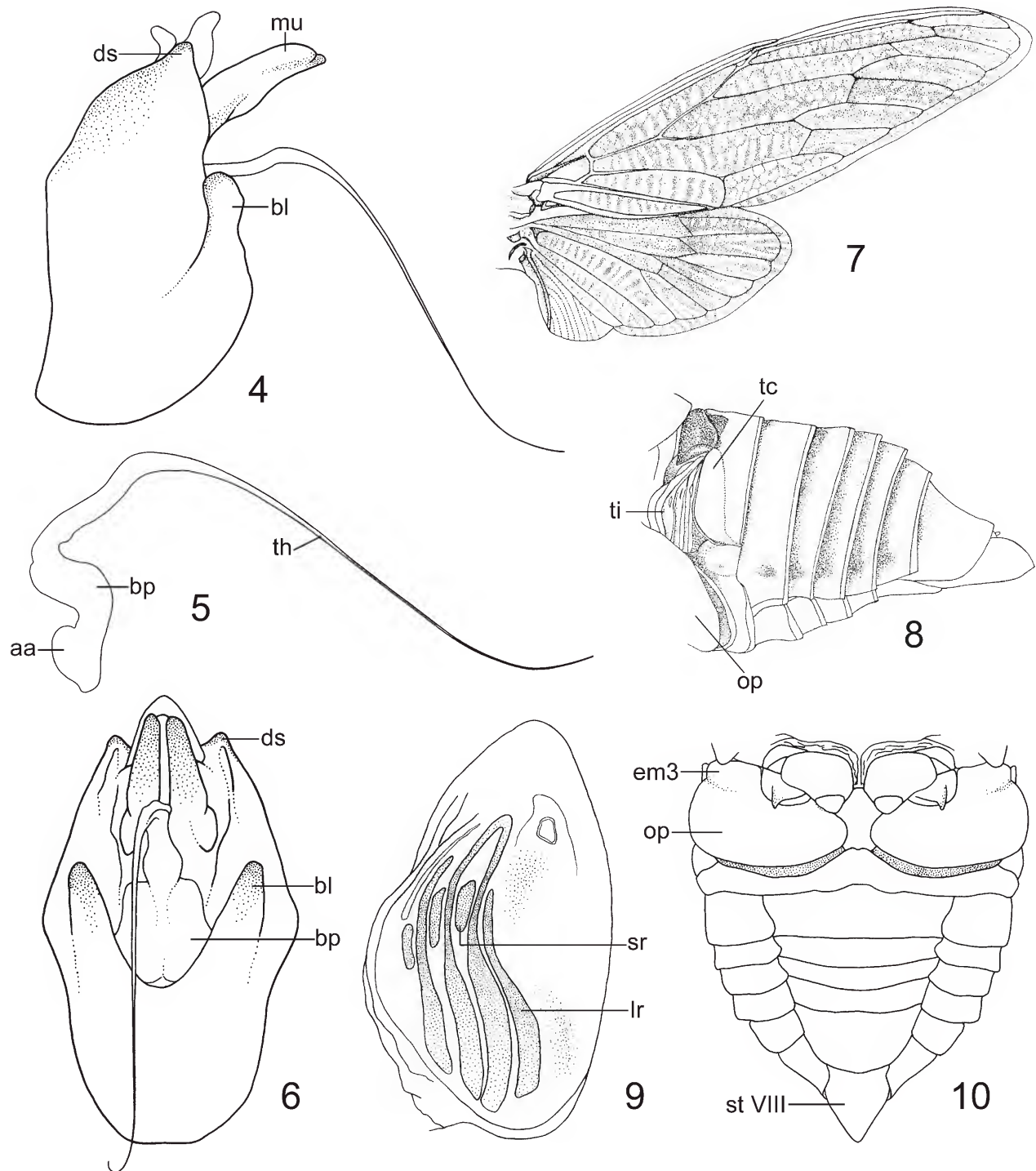
Abdomen (Figs 1–3, 8, 10). Male abdomen shorter than head plus thorax; that of female much longer. Male abdominal tergites with their sides weakly convex in cross-section, not partly concave; male tergites 2 and 3 larger than tergites 4–7; male sternites 3–7 gently convex in cross-section. Timbal covers (Fig. 8) small, covering no more than half timbal cavity. Timbals (Fig. 9) with large basal dome, the

type species with four long ribs spaced with prominent intermediate short ribs.

Male genitalia (Figs 4–6). Pygofer with distal shoulder extended into bluntly-pointed lobe; basal lobe undivided, broadly rounded; dorsal beak absent. Aedeagus restrained by tubular encapsulation on ventral surface of uncus; basal plate in lateral view sharply angled through 90° ; in dorsal view apical arms short, base broad and long with midline deeply furrowed; basal portion of basal plate directed forwards away from thecal shaft; junction between theca and basal plate rigid, without a “hinge”; thecal shaft gently curved; thecal apex entirely chitinized, thecal subapical cerci absent; legula absent; conjunctival claws absent; vesica retractable, vesica opening apical on theca.

Distinguishing characters

Fresh specimens have much of their body “dusted” white. The genus is best distinguished from all other Australian genera by the characters used for distinguishing the tribe as listed above.



Figs 4–10. *Talcopsaltria olivei* n.sp., male: (4) genitalia, lateral view; (5) the same, aedeagus, lateral view showing basal plate; (6) the same, ventral view; (7) fore and hind wings showing undulations of wing membrane; (8) lateral view of body showing reduced timbal cover; (9) left timbal; (10) ventral view of body showing opercula and abdomen. Abbreviations: *aa* apical arm of basal plate, *bl* basal lobe of pygofer, *bp* basal plate, *ds* distal shoulder of pygofer, *em3* remnant of epimeron 3, *lr* long rib, *mu* median lobe of uncus, *op* operculum, *sr* short rib, *st VIII* sternite eight, *tc* timbal cover, *th* theca, *ti* timbal.

Discussion

The talc-like “dusting” on the body, both above and below, results from a very fine white waxy exudation. This white exudation is not uncommon in cicadas, occurring in many genera. It is, however, particularly extensive in *Talcopsaltria*, covering virtually the entire head and body of fresh specimens. It wears off with age and is easily removed from museum specimens by touching the body surface, relaxing of specimens for setting and wetting with alcohol or other solvents.

Talcopsaltria olivei n.sp.

Figs 1–13

Species B—Ewart, 1993: 137–138, fig. 5; 2005: 177, fig. 10.

Types. HOLOTYPE male, Queensland, McIvor River road, 7 km from Isabella Falls, 35 km NW of Cooktown, 15°18.0'S 145°00.2'E, 9 Jan. 2006, J. Olive (QM). PARATYPES as follows: 5 males, 18.2km NW. Heathlands Stn., Cockatoo Ck–Heathlands Rd., Cape York Pen., 11°39.19'S 142°27.36'E, 28 Jan. 1992, *E. tetradonta* forest, A.E. [Ewart]; 1 male, as previously, 2 Feb. 1992; 4 males, as previously, 3 Feb. 1992 (AE). 1 male, AU.QLD.APX, 3 km W of Archer Point, 15°35.765'S 145°17.718'E, 57 m, 15 Jan. 2005, Hill, Marshall, Moulds (AM). 1 male, McIvor River road, 7 km from Isabella Falls, 35 km NW of Cooktown, 15°18.0'S 145°00.2'E, 9 Jan. 2006, J. Olive; 2 males, same locality, 7 Jan. 2007, J. Olive; 2 males, 1 female, same locality, 12 Jan. 2004, J. Olive; 2 males, same locality, 29 Mar. 2008, J. Olive; 2 males, 1 female, Archer Point road, S of Cooktown, 15°35.76'S 145°17.72'E, 12 Jan. 2003, D. Millar; 3 males, 1 female, same locality, 12 Jan. 2003, J. Olive; 1 male, same locality, 15 Jan. 2005, J. Olive; 1 male, same locality, 6 Jan. 2007, J. Olive (JO). 2 males, 1 female, 3 km NW of Archer Riv. x-ing, 13°24'S 142°55'E, 11 Apr. 1989, G. and A. Daniels; 1 female, AU.QL.NCO, 46 km N of Coen, 13°34.911'S 143°01.883'E, 127 m, 10 Jan. 2007, K. Hill, D. Marshall, M. Moulds; 1 female 7 km from Isabella Falls, 35 km NW of Cooktown, 15°18.0'S 145°00.2'E, 12 Jan. 2004, J. Olive; 3 males, 3 females, AU.QLD.APX, 3 km W of Archer Point, 15°35.765'S 145°17.718'E, 57m, 15 Jan. 2005, Hill, Marshall, Moulds; 1 male (genitalia prep. THE 1), Archer Point road, S of Cooktown, 15°35.76'S 145°17.72'E, 12 Jan. 2004, J. Olive (MSM). 2 males, McIvor River road, 7 km from Isabella Falls, 35 km NW of Cooktown, 15°18.0'S 145°00.2'E, 12 Jan. 2004, J. Olive (PH). 1 female, McIvor River road, 7 km from Isabella Falls, 35 km NW of Cooktown, 15°18.0'S 145°00.2'E, 9 Jan. 2006, J. Landy (QM).

Etymology: Named in honour of John Olive who collected the majority of specimens.

Description

Male (Figs 1, 3–6, 8–10): The head, thorax and abdomen are extensively “dusted” with a fine, white, waxy exudation, both above and below. Traces of this “dusting” can also be found scattered along the larger wing veins.

Head light to mid brown, variable between individuals; vertex with a black fascia of irregular width from eye to eye, surrounding each ocellus and branching to each supra-antennal plate; front of head with a narrow black fascia from eye to base of antenna and a short extension that follows postclypeal margin; anterior margin of eye socket finely edged black; anterior and posterior cranial depressions black; supra-antennal plates yellow along anterior margin. Postclypeus light brown, black along transverse grooves, in central part of depressed midline and at either side of “top”. Anteclypeus light brown with partly black rim and a large black patch along midline. Lorum light brown with partly glossy black margin. Rostrum pale brown, reaching beyond hind coxae; labium becoming black apically. Antennae dark brown, tending black in parts.

Thorax (Figs 1–3) light brown with black markings, pronotal collar olive green on fresh specimens with fine black edge to lateral margins. Pronotum with a pair of narrow black fasciae that are flanged at each end, one of these either side of

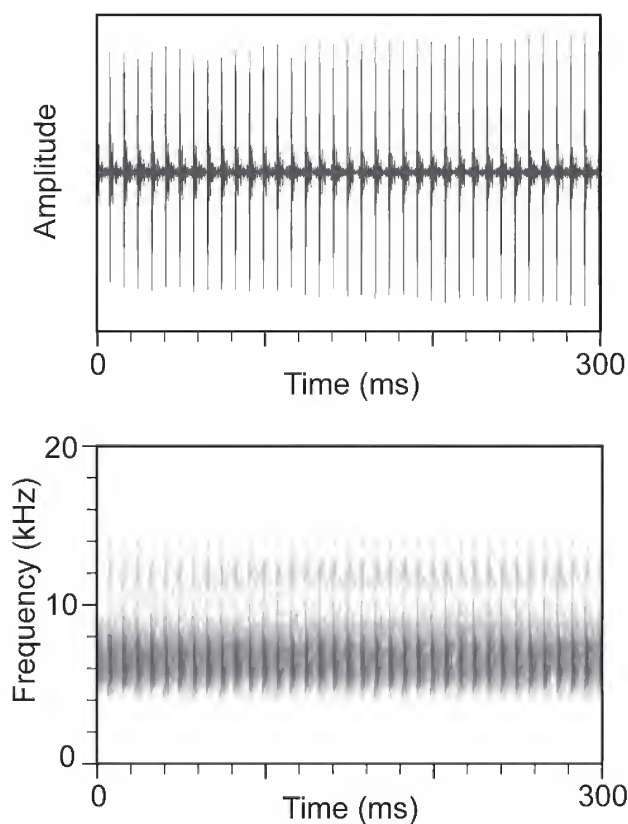


Fig. 11. Calling song of *Talcopsaltria olivei* n.sp.: oscillogram showing individual pulses of the song, above; sonogram at corresponding time scale showing frequency range, below.

midline; paramedian and lateral fissures marked with black; ambient fissure narrowly edged black. Mesonotum with submedian sigilla outlined black; outer margins of lateral sigilla black; ill-defined black markings at base of inner margin of lateral sigilla and between apices of submedian sigilla and cruciform elevation; black along wing groove; a black spot across each anterior arm of cruciform elevation before distal end; scutal depressions black. Metanotum black with distal rim light brown.

Wings (Figs 1–3, 7) hyaline, without infuscations, the wing membranes with more undulations than normal. Fore wing venation mostly brown, R+Sc palest; nodal region and depression between C and R+Sc often black; basal cell opaque, the distal portion and delimiting veins partly black; 3A black adjacent to basal membrane; basal membrane white or nearly so. Hind wing venation brown; 3A black; plaga white except for black abutting along 3A.

Legs pale to light brown; usually with indistinct longitudinal black fascia most obvious on fore legs; fore coxae often with either end partly rimmed black; fore trochanter often with a black blotch on shortest length; femora with a small black spot either side at distal end; tibiae usually with a black spot either side at proximal end and distal end usually with some black of variable extent; tarsi black at distal end, especially so on fore and mid tarsi; pretarsal claws black on apical half, dark brown on basal half. Meracanthus partly black basally, spur light brown.

Opercula (Fig. 10) pale yellowish brown, epimeron 3 a little darker and partly black.

Abdomen (Figs 1, 2, 8, 10). Tergites light to mid reddish brown, tending glossy. Tergite 1 almost entirely black; tergite 2 usually with a black blotch either side of midline near anterior margin, tergites 3–8 each with a black fascia on or near to anterior margin and usually restricted or broken on abdominal midline. Sternites light brown, glossy; sternite 8 sometimes tipped black. Timbal covers brown, usually with black suffusion. Timbals (Fig. 9) with four long ribs spaced with prominent intermediate short ribs.

Genitalia (Figs 4–6). Pygofer basal lobes evenly rounded apically; pygofer distal shoulder well developed, in lateral view broad, triangular and bluntly pointed. Uncal median lobe in lateral view nearly parallel-sided with an angled blunt apex, in dorsal view gradually tapering towards apex, slightly outwardly swollen just before apex, thereafter abruptly curving inwards to a short blunt point. Aedeagus with theca long, slender and tubular; the proximal quarter thickest, curved gently backwards and a little swollen distally; the remainder gently curved forwards proximally, gently backwards distally, gradually tapering to a simple angled apex.

Female (Fig. 2): Similar to male. Abdominal segment 9 brown with a pair of black subdorsal fasciae parallel with abdominal midline reaching a little over half way to dorsal beak, each fascia extended laterally to ventral surface along anterior margin of abdominal segment 9; sometimes a pair of small, curved fascia between distal ends of subdorsal fascia.

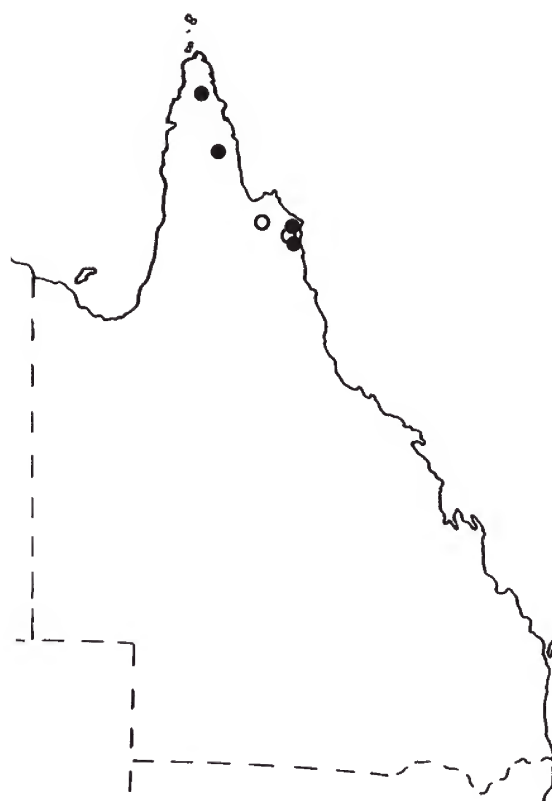


Fig. 12. *Talcopsaltria olivei* n.sp., distribution. Solid dots are capture records; circles are aural records.

Measurements

Range and mean (in mm) for 10 males and 9 females; includes smallest and largest of available specimens. *Length of body*: male 22.5–28.5 (26.0); female 25.3–28.2 (26.8). *Length of forewing*: male 30.9–39.2 (36.0); female 37.4–41.0 (38.7). *Width of forewing*: male 9.7–11.9 (11.0); female 10.9–12.4 (11.6). *Ratio width/length of forewing*: male 3.3 ± 0.2 ; female 3.3 ± 0.2 . *Width of head (including eyes)*: male 8.8–11.3 (10.4); female 9.9–11.4 (10.9). *Width of pronotum (across lateral angles)*: male 9.6–12.3 (11.5); female 11.1–13.2 (12.3).

Song (Fig. 11): Ewart (1993, 2005) described and analyzed the song and provided waveform plots for specimens from Heathlands. He noted that periods of singing for four individuals lasted 12, 17, 18 and 25 minutes respectively. To the human ear the song has a buzzing quality, uninterrupted and without variation. As noted by Ewart the song actually consists of a sequence of rapid single pulses. These pulses are extremely short, each only about 1 ms in duration.

Ewart measured the pulse rate at some 130 per second with a frequency lying between 6 and 8 kHz. A recording of a specimen from north of Cooktown made by David Marshall (Fig. 11) showed a pulse rate of 120 per second with the majority of sound energy in the range 5–8 kHz with dominant frequencies between 6 and 6.5 kHz. Differences between the recordings of Ewart and Marshall are most likely due to differences in temperature (pulse rate) and individual variation (frequency).

The species is unusual for a large cicada in that it has no alarm call.

Distribution, habitat and behaviour (Fig. 12)

Cape York Peninsula, Queensland, south from Heathlands, through the Coen and Laura districts to Archer Point near Cooktown. There are records from five main localities: Heathlands in the far north (11°39'S 142°27'E), just north of the Archer River crossing on the main Peninsula Development Road (around 13°30'S 143°30'E), between Laura and the Old Laura Homestead (around 15°25'S 144°25'), north of Isabella Falls some 35 km NW of Cooktown (15°18'S 145°00'E), and 3 km W of Archer Point, south of Cooktown (15°36'S 145°18'E). Aural records include a little west of the road junction north of Isabella Falls, and between the Old Laura Homestead and Laura (J. Olive, pers comm.). There are records from 6 January to 11 April but most specimens have been taken during January and February.

Adults are usually found high in *Eucalyptus tetradonta* where they prefer the upper trunk and main limbs. They tend to be well camouflaged against the rough bark of the eucalypts, assisted in part by the black markings on the head and thorax and the black infuscations at the rear of the fore wings that form two longitudinal black bars overlaying the pale body when the wings are at rest (Fig. 3). On capture adults often play dead and there is no alarm call. Tony Ewart also noted that when specimens were attracted to light they simply dropped to the ground and lay still making it difficult to locate them. Populations tend to be localized, extending at most for just a few hundred metres.

ACKNOWLEDGMENTS. For comments on the manuscript I am grateful to Tony Ewart, Kathy Hill and David Marshall. I thank John Olive and Tony Ewart for access to specimens in their collections. Greg Daniels kindly donated the first known specimens. For field assistance and helping collect specimens I am grateful to Kathy Hill and David Marshall. Photographs for Figs 1 and 2 were taken by Philip Tio. For other figures I am grateful to Lindsay Chandler (Figs 4–6, 9–10), Katie Schuler (Figs 7, 8) and David Marshall (Fig. 11). Tony Ewart kindly provided access to preliminary figures he had prepared and to the figures prepared by Katie Schuler.

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<http://dx.doi.org/10.3853/j.0067-1975.57.2005.1447>

Manuscript submitted 24 November 2007, accepted 12 August 2008.

Devonian Syringostromatid Stromatoporoids from the Broken River Region, North Queensland

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ABSTRACT. Six species of syringostromatid stromatoporoids are described from the biostratigraphically well-constrained carbonate successions of the Broken River region, North Queensland; the various occurrences range from earliest Devonian (early Lochkovian) to Mid-Devonian (late Eifelian). Included are three new Lochkovian species, *Atopostroma stearni* from the uppermost part of the Jack Formation and the Martins Well Limestone Member of the succeeding Shield Creek Formation, *A. protentum* and *Habrostroma alternum* also from the Martins Well Limestone Member. Transitional forms between the species of *Atopostroma* and *Habrostroma* are recorded from the Martins Well fauna. In addition *Atopostroma distans* (Ripper, 1937) is found in the Lomandra Limestone (late Emsian), and is present in reworked pebbles of the Dip Creek and the Chinaman Creek limestones of possible late Emsian-Eifelian. Sparse records of *Columnostroma* sp. in the Mid-Devonian (late Eifelian) Dosey Limestone, and reworked clasts of *Parallelopora* sp. in the Chinaman Creek Limestone, also occur. Characteristic structural elements of syringostromatid fauna are described including pachysteles, pachystromes and microlaminae, and microreticulate (acosmoreticular and clinoreticular) microstructures in the best preserved specimens. Also aspects of the evolutionary development of the fauna and the nature of the preservation of certain structural elements are discussed.

WEBBY, BARRY D., & YONG YI ZHEN, 2008. Devonian syringostromatid stromatoporoids from the Broken River region, North Queensland. *Records of the Australian Museum* 60(3): 215–236.

This contribution is the second documenting the morphological features of the Devonian stromatoporoids of the Broken River region, North Queensland (Fig. 1), this time focusing almost entirely on descriptions of the syringostromatid fauna. The earlier work of Webby & Zhen (1997) was devoted to describing 31 species, representing more than half the orders of the class Stromatoporoidea from the region, namely the labechiids, actinostromatids, clathrodictyids and stromatoporellids. One of these described stromatoporellids was a dendroid species, *Stachyodes costulata* Lecompte, 1952, from the late Givetian or Frasnian

Stanley Limestone Member of the Mytton Formation of the SD192S section of the Broken River region, now also assigned to the syringostromatids.

The only other significant contribution on Devonian stromatoporoids of North Queensland since our earlier (1997) publication is that of Cook (1999) describing 35 stromatoporoid taxa from the Middle Devonian Fanning River Group of the Burdekin Basin, from an area about 180 km to the east (Fig. 1). Included are descriptions of a number of Middle Devonian (Givetian) syringostromatids—two species of *Coenostroma*, *C. burdekinense* Cook, 1999, and

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C. wyatti Cook, 1999, a species left in open nomenclature that was ambiguously recorded as a *Parallelostroma* or *?Parallelopora* (Cook, 1999, p. 542), and four species of *Stachyodes*, namely, *S. crassa* Lecompte, 1952, *S. costulata* Lecompte, 1952, *S. sp. A*, and *S. sp. B*.

Stratigraphic distribution

All the Devonian syringostromatids known from the Broken River region are described herein, except for the species of *Stachyodes* mentioned above. They comprise *Atopostroma distans* (Ripper, 1937), *A. stearni* n.sp., *A. protentum* n.sp., *Habrostroma alternum* n.sp., *Columnostroma* sp. and *Parallelopora* sp.

In terms of the stratigraphic succession (Figs 1–2), the occurrence of *Atopostroma stearni* n.sp. in the topmost part of the Jack Formation (upper limestone member) at the western end of the Broken River Gorge (Grid reference: 7859-655455) is the earliest record of the genus in Australia from a horizon that is very close to the Silurian–Devonian boundary, most probably earliest Lochkovian in age (Jell *et al.*, 1993, p. 240) rather than latest Pridoli. *Atopostroma stearni* ranges up into the Martins Well Limestone Member of the Shield Creek Formation, occurring through a 35 m interval above the base of the NE–SW orientated MW section at Martins Well (Grid reference: 7859-685684; see Fig. 1), of late Lochkovian–early Pragian age. Another species of *Atopostroma*, *A. protentum* n.sp. occurs through the same interval, and a species of *Habrostroma*, *H. alternum* n.sp., is associated, though it has a more restricted distribution within the lower, 1–8 m thick, interval (late Lochkovian) of the Martins Well Limestone Member. These Martins Well species of *Atopostroma* and *Habrostroma* are of interest in exhibiting a range of transitional forms, especially between *A. protentum* and *H. alternum*. Stearn (1993, p. 221) has previously commented on this relationship, though he made the comparison with *Parallelostroma* rather than *Habrostroma*. The particular species has the characteristic acosmoreticular microstructure of *Habrostroma*. No species of *Parallelostroma* with a typical orthoreticular microstructure are known from the Broken River region.

Another species of *Atopostroma*, *A. distans* (Ripper, 1937), is described from the Broken River succession but from higher in the succession, through a 64 m thick interval within the Lomandra Limestone of late Emsian age in the SD170 section (Grid reference: 7858-611408; Fig. 1). One illustrated specimen of the species from this locality is exceptionally well preserved (see Fig. 3A, C–D, F). The species is also present in reworked pebbles of both the Dip Creek and Chinaman Creek limestones, of probable late Emsian or Eifelian age. *Atopostroma distans* has a wide distribution in eastern Australia in Victoria and central New South Wales. In the type locality in eastern Victoria it occurs in the Buchan Caves Limestone of early Emsian age (Webby *et al.*, 1993). It has been claimed to have a much wider distribution, with the occurrences recorded by Stearn (1983), and Prosh & Stearn (1996) from the Emsian of Arctic Canada and the Yukon seeming to be genuinely conspecific, but May's (1999, 2005) suggestion that *A. distans* is a junior synonym of the poorly preserved *Atopostroma frustulum* (Pořta, 1894) from the Pragian of the Czech Republic is unacceptable given its coarser microreticular patterns and thicker pachysteles.

Other syringostromatid material collected from the Broken River region is rather limited and poorly preserved. *Columnostroma* sp. has been recorded from the Dosey Limestone (upper Eifelian), 11 m above the base in the SD260 section, from 2 km NNW of Storm Hill (Grid reference: 7858-548407), and *Parallelopora* sp. is reported from reworked pebbles of the Chinaman Creek Limestone (Grid reference: 7859-690601), having an uncertain, possibly late Eifelian age.

Background of previous work

Stearn (1980) proposed a new classification of Palaeozoic stromatoporoids that employed the structural elements as the main diagnostic features for the subdivision of the group. In that classification he introduced the new order Stromatoporida Stearn, 1980, comprised of three families—the Stromatoporidae, Syringostromellidae and Syringostromatidae—these groups being differentiated mainly on the differences in their amalgamated networks of longitudinally directed, wall-like elements termed pachysteles, and tangentially aligned layers called pachystromes and one or more thin laminae or microlaminae (Stearn, 2007, p. 559). In his new classification, Stearn (1980) preferred to minimize the emphasis on microstructures for higher-level classification because of the pervasive influence of diagenesis in changing the original state of stromatoporeid skeletons, thus making them difficult to apply.

However, Stearn (1993) in his major revision of the order Stromatoporida, while continuing to recognize the importance of structural elements, acknowledged as equally significant the cellular and microreticulate microstructures that were present across the group as a whole, with cellular microstructures in genera belonging to the families Stromatoporidae and Syringostromellidae, and microreticulate microstructures confined to the genera of family Syringostromatidae. The earlier contributions on the nature and origins of microreticular microstructures by Parks (1909, 1936), Kaźmierczak (1971), Nestor (1974) and Stock (1989) helped to explain how microreticulate microstructures may have originated, and how they could be used in classifying the group. Microstructural differences were fundamentally important in differentiating between the two groups and the order Stromatoporida Stearn, 1980 was polyphyletic. Consequently, Stearn (Stearn, 1993; Stearn, *in* Stearn *et al.*, 1999) redefined the order Stromatoporida to include only the genera exhibiting a cellular microstructure, and order Syringostromatida Bogoyavlenskaya, 1969 was reinstated as a name to encompass the genera with a microreticulate microstructure—though Bogoyavlenskaya's (1969, p. 21) original diagnosis of Syringostromatida made no mention of microstructure, and adopted a different conception with inclusion of some stromatoporellid family groups. In terms of origins, Stearn (1993) suggested that two orders arose independently during the Early Silurian (Llandovery) from different stocks—the revised order Stromatoporida derived from the Clathrodictyida, and the restored order Syringostromatida, from the Actinostromatida, or at least from one of its families, the Densastromatidae Bogoyavlenskaya, 1974.

Only one family, the Syringostromatidae Lecompte, 1952, was initially included in the order Syringostromatida (Stearn, 1993), but the classification has been successively

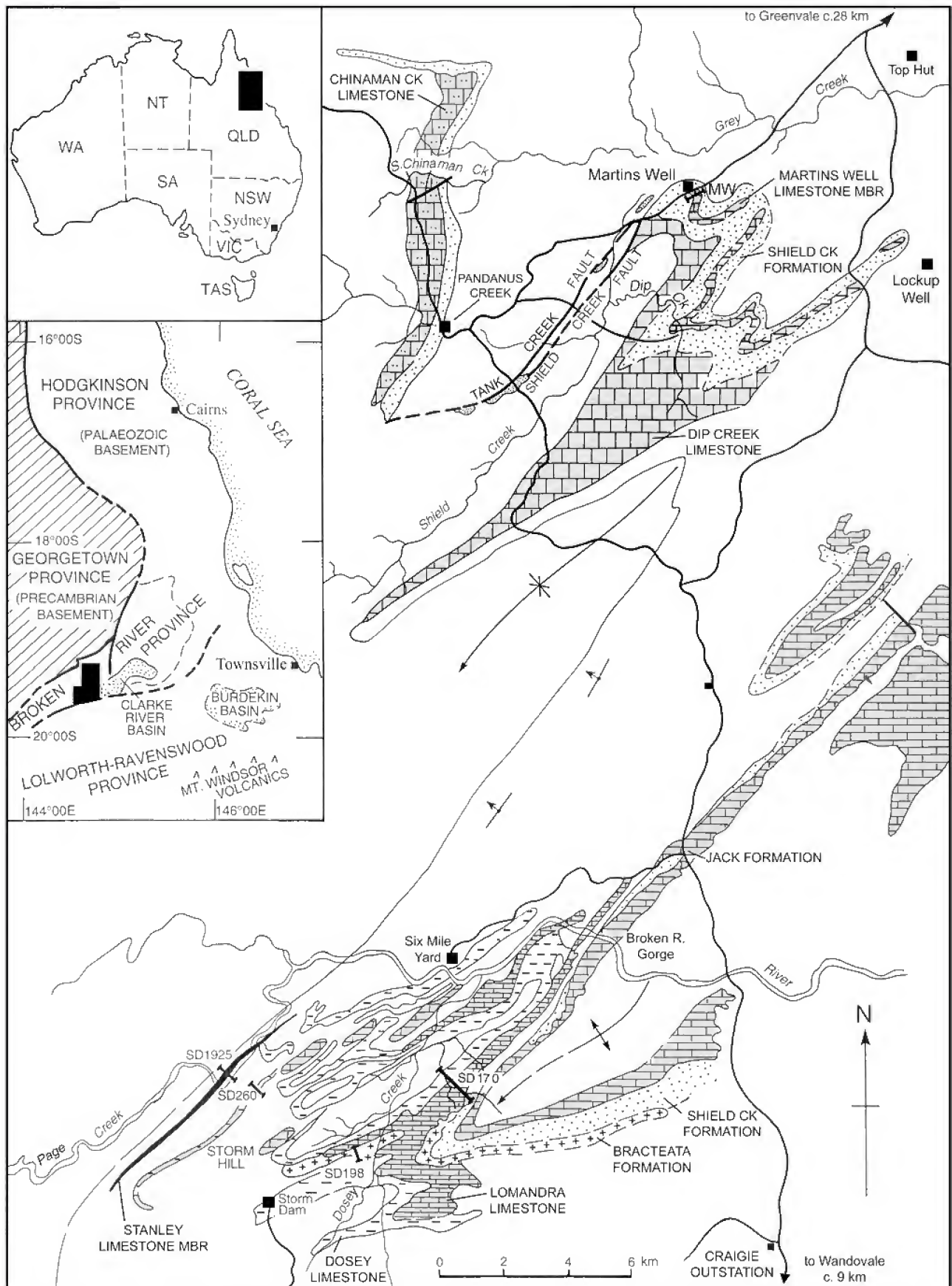


Fig. 1. Map of the Broken River region, north Queensland, showing the main areas of exposure of Upper Silurian and Devonian carbonate rocks, and locality data including identification of stratigraphic units and location of sections bearing the stromatoporoids described herein. Sources of geological mapping are after Withnall *et al.* (1988); Withnall & Lang (1993), with additions including location of SD and MW sections after Mawson *et al.* (1988), Mawson & Talent (1989), and Sloan *et al.* (1995).

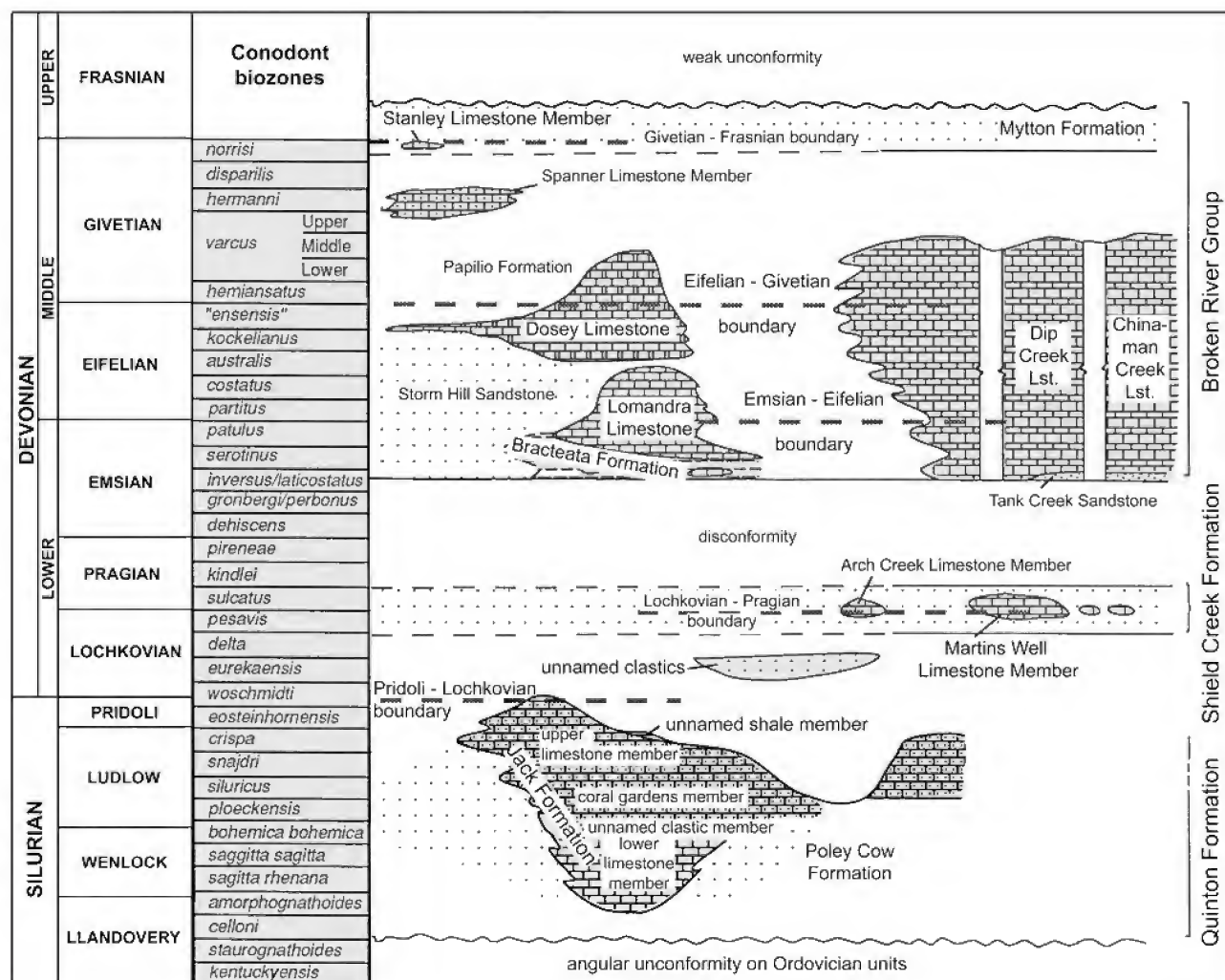


Fig. 2. Stratigraphic chart to illustrate the age relationships of the Silurian to Devonian successions across the Broken River region of North Queensland, from northern to southern parts of the area (that is, from right to left sides of chart), based on conodont data presented in Mawson *et al.* (1988), Mawson & Talent (1989), and Sloan *et al.* (1995; see especially text-fig. 3).

modified by Stearn in more recent years, in line with his evolving views, to a subdivision into three families—the Syringostromatidae, Coenostromatidae Waagen & Wentzel, 1887, and Stachyoditidae Khromykh, 1967 (see Stearn, *in Stearn et al.*, 1999). Then, in the hypercalcified sponge volume of the *Treatise on Invertebrate Paleontology* volume, Stearn (in press) excluded the name Syringostromatidae, in favour of a revised and enlarged Coenostromatidae, and the addition of family Parallelostromatidae Bogoyavlenskaya, 1984. What has become crucially important in syringostromatid classification is the nature of the microreticulate microstructure, though it does not by itself define the group.

Three different kinds of microreticulate microstructure have been recognized within pachystele and pachystromal elements of the syringostromatids by Stock (1989), and in Stearn *et al.* (1999—see definitions on p. 8 therein). These comprise: (a) regular longitudinally aligned grid-like patterns (orthoreticular); (b) upwardly diverging patterns (clino-reticular); and (c) irregularly arranged (acosmoreticular), patterns of micropillars and microcolliculi, with sometimes the latter two types being gradational between each other. In the latest version (in the unpublished *Treatise* volume), Stearn (in press) includes a classification of syringostromatids, with

the coenostromatid genera usually characterized by showing clinoreticular and/or acosmoreticular microstructure, and the parallelostromatid genera typically exhibiting an orthoreticular microstructure. In that contribution, Stearn assigns a total of eight genera—the coenostromatids *Atopostroma*, *Coenostroma*, *Columnostroma*, *Habrostroma* and *Syringostroma*, the parallelostromatids *Parallelostroma* and *Parallelopore*, and the stachyoditid *Stachyodes*—to the order Syringostromatida.

In terms of the origins of the Syringostromatida, Stearn (1993, pp. 208–210) has recognized that it is likely that the group arose from the family Densastromatidae of the order Actinostromatida. A number of morphological resemblances have been noted between the two major groups. Though the characteristic patterns in actinostromatids of coarse-textured, hexactinellid-type, skeletons with long pillars and beam-like colliculi, as well as a compact microstructure, (Stearn, *in Stearn et al.*, 1999), are features not shared by syringostromatids, the finer-textured, “microreticulated” skeletons composed of micropillars and microcolliculi (Stock & Burry-Stock, 1998; Stock, *in Stearn et al.*, 1999), do resemble the microreticulate microstructures of syringostromatids. However, these densastromatid structures are strictly small-scale primary skeletal elements, rather than

microstructures that form amalgamated nets within the larger primary macrostructural elements of syringostromatids, that is, within their pachysteles and pachystromes (Stearn, 1993; Stearn, in Stearn *et al.*, 1999).

Stearn (1993, p. 210) and Stearn *et al.* (1999, p. 51) suggested that the Syringostromida arose from the Actinostromatida (specifically the densastromatids) during the Early Silurian, and that the actinostromatid genus *Plectostroma* Nestor, 1964, may have been the rootstock to the finer-textured densastromatid lineage that first evolved early in the Wenlock. The syringostromatid genus *Parallelostroma* Nestor, 1966 was considered to have descended later from that densastromatid stock, probably in the late Wenlock. Stearn (1993, text-fig. 4) interpreted *Parallelostroma* as ancestral to most of the Early-Mid Devonian, syringostromatid genera, but it exhibits an orthoreticular microstructure that contrasts with the dominantly clinoreticular and acosmoreticular microstructures of the majority of Early-Mid Devonian genera. It seems likely that the integrity of individual microstructural types would have been retained within lineages through time. Therefore, an alternative viewpoint is proposed namely, that the Devonian genera evolved independently from other lines of descent during the Silurian, probably from another densastromatid, or a pseudolabechiid, descendant lineage with ancestral acosmoreticular and clinoreticular microstructures (Nestor, 1974; Stock & Burry-Stock, 1998, Stock, in Stearn *et al.*, 1999).

In the Broken River region, close relationships exist between the genera *Habrostroma* and *Atopostroma*, given they both exhibit acosmoreticular and clinoreticular microstructures, and show transitional relationships at the species level across both genera within the late Lochkovian-early Pragian Martins Well Limestone Member, as described herein. Neither appears to have been derived from an orthoreticulate genus like *Parallelostroma*, though more work needs to be done to properly reassess whether all Late Silurian species described as *Parallelostroma* are truly members of this genus. The genus *Habrostroma*, for example, based on *H. kaugaticum* (Riabinin), has been confirmed from Upper Silurian (Pridoli) successions in New York and Virginia, USA (Stock, 1989, fig. 2E,F), but this same Pridolian species in Estonia (see Nestor, 1999) has been retained as a species of *Parallelostroma*. The genus *Atopostroma* appears in the earliest Devonian (early Lochkovian), as demonstrated here by the first occurrences of *A. stearni* in the uppermost part of the Jack Formation in the Broken River region, and the same species occurs in Arctic Canada, perhaps a little later, in the late Lochkovian (Stearn, 1990), that is, from an equivalent stratigraphic interval to that sampled at Martins Well where the range of transitional forms between *Atopostroma* and *Habrostroma* occur. Not only are there transitional forms associated with *A. protentum* and *H. alternum* in the Martins Well section, but specimens of *A. stearni* also showing gradational tendencies to *A. protentum* and *H. alternum* in that section. It seems possible therefore that, though *Atopostroma* may have evolved from *Habrostroma* at the beginning of the Devonian, a range of transitional morphologies may have existed throughout Lochkovian time, or alternatively these gradational changes across two genera may be more related to differences in preservational types. Only by collecting and studying large numbers of samples of these taxa in Lochkovian sequences elsewhere will it be possible to test these alternative suggestions.

Systematic palaeontology

The majority of stromatoporoid specimens used in this study have been collected by Webby, and precisely located in the measured sections of J.A. Talent, R. Mawson and colleagues from Macquarie University. In addition the specimens are positioned with respect to the grid references contained on the 1:100 000 Broken River Special geological map of Withnall & Lang (1992), and the Queensland 1:100 000 Topographic Map Sheets 7858 (Wando Vale) and 7859 (Barges). This material has been designated Australian Museum (AM F.) catalogue numbers for the type and figured specimens (hand specimens) with a separate set of registration numbers (AM FT. numbers) for each individual thin section, in most cases allocated on the basis of two numbers for each specimen, representing pairs of longitudinally and tangentially orientated thin sections of each specimen. Other Broken River samples were collected by C.W. Mallett in the 1960s and some of these were used in the present descriptions. The specimens were catalogued by Mallett using the prefix UQF and registered by their locality numbers using the prefix UQL; all the material was housed in the Geology Department of the University of Queensland, and now in the Queensland Museum.

The terms pachystele, pachystrome and allotube (Stearn, 2007, p.559; Stearn, in Webby *et al.*, in press, in the "Glossary" of the forthcoming *Treatise* volume on hypercalcified sponges) are used in this contribution in preference to terms coenostele, coenostrome and coenotube, as defined previously in Stearn *et al.* (1999, p.5); these latter are no longer recommended for use because the terms have connotations with common colonial forms like cnidarians.

Class Stromatoporoidea

Nicholson & Murie, 1878

Order Syringostromatida

Bogoyavlenskaya, 1969

Family Coenostromatidae

Waagen & Wentzel, 1887

Atopostroma Yang & Dong, 1979

Type species. *Atopostroma tuntouense* Yang & Dong, 1979.

Diagnosis: Pachysteles (pillars, in poorly preserved condition) moderately thick, superposed, inverted conical to post- and spool-shaped; microstructure usually microreticular. Pachystromes (seem to be laminae in less well preserved state) are laterally extensive and variably thickened; differentiated into thin, sharply defined, flattened, laterally persistent, microcolliculate bounding microlamina at top and, where well enough preserved, underlain by irregularly spread network of microreticular material that joins pachysteles, and may include other close-spaced, but more discontinuous, microlaminae; pachystrome floors irregular, best defined in dome-shaped contacts over galleries. Dissepiments rare, widely scattered, either small cyst-like, or long, wavy, microlamina-like plates. Microreticular structure of skeleton composed of variable fine network of micropillars and microcolliculi in microlaminae; in tangential section microstructures composed of acosmoreticular material;

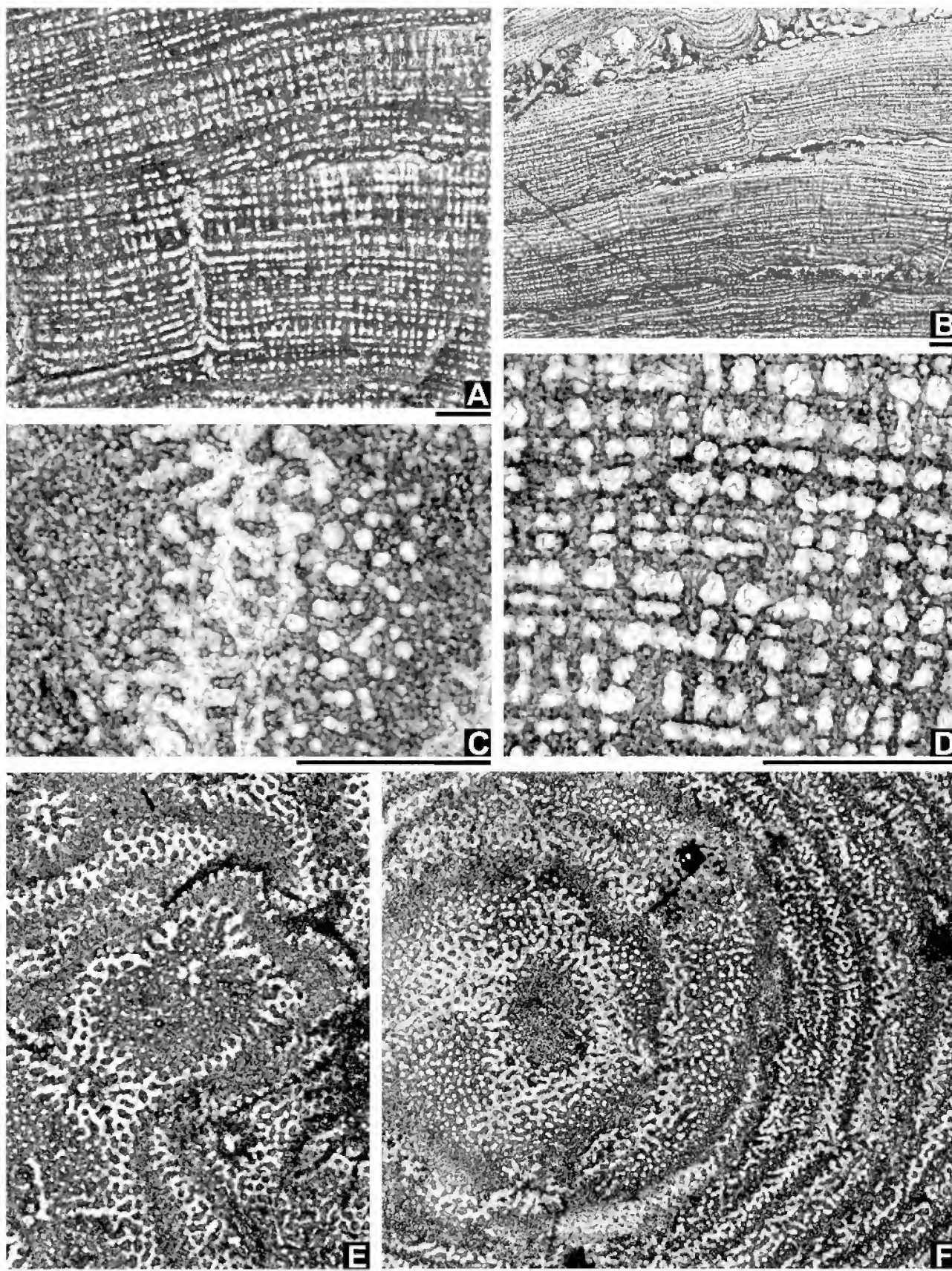


Fig. 3. *Atopostroma distans* (Ripper, 1937): A, C, D, F, from Lomandra Limestone in SD170 section (210 m above the base); (A) longitudinal section, AM F.134879 (AM FT.15066), $\times 10$; (B) longitudinal section, UQF.47741B from locality UQL.2980 of Mallett (1968), from Dip Creek Limestone, 1 km SW of Martins Well, $\times 5$; (C) tangential section, AM F.134879 (AM FT.15067), showing enlarged small area (centre left in Fig. 3F), with irregularly shaped pachystyles in open, spar-filled, interlaminar, ...[continued on facing page]

microreticular features of pachysteles and pachystromes are also largely acosmoreticular in longitudinal section, except clinoreticular where pachystele margins diverge upwards; sometimes microreticular features masked by diagenetic alteration, leaving skeletal elements preserved predominantly with melanospheric to compact microstructures.

Discussion. Yang & Dong's (1979, p. 74) original generic diagnosis included: laminae thin, compact, without thickened material; pillars thick, upward spreading, superposed across a few laminae, with connecting radial processes; astrorhizae rudimentary; no "pseudozooidal" tubes [=allotubes]; microstructure cellular or maculate. The maculae were apparently darker spheres on a lighter background (equivalent to the melanospheres of Stearn, 1965, 1966). Though resembling *Actinostroma* (given the recognition of hexactinellid type "connecting processes" of actinostromatids), Yang & Dong preferred to group *Atopostroma* as belonging to family Stromatoporidae, and this position was maintained by Dong & Wang (1982) and Wang (1988) in subsequent descriptions of Chinese species. Stearn (1980, 1983) on the other hand favoured a grouping of *Atopostroma* within the Clathrodictyidae because of the characteristic spread of thick, superposed, pillars beneath successive, thin, single-layered laminae (or microlaminae), which suggested a close relationship with clathrodictyid genus *Gerronostroma*. Also, Stearn (1966, p. 101) suggested *Actinostroma stellulatum distans* Ripper, 1937 as a species of *Gerronostroma* (see further discussion below). Mistiaen (1985) however argued that the microstructure in *Gerronostroma* was not the same, and preferred a separate grouping for *Atopostroma*.

Later, Stearn (1990) identified a clinoreticular microstructure in "pillars" of a form he called *Atopostroma tuntouense* from Stuart Bay, Bathurst Island, in Arctic Canada, but not identical with the type species—see Webby *et al.* (1993, p. 173). Additionally, Stearn (1993) reassigned *Atopostroma* to the family Syringostromatidae based on the presence of a microreticular microstructure within the order Syringostromatida. Webby & Zhen (1993) and Webby *et al.* (1993) then followed Stearn's lead, reinterpreting the taxon *Actinostroma stellulatum distans* Ripper, 1937, as another valid representative of genus *Atopostroma*. Others—see Prosh & Stearn (1996), Stearn, *in Stearn et al.* (1999), and May (1999, 2005)—have maintained the grouping of *Atopostroma* within the family Syringostromatidae (order Syringostromatida). As mentioned earlier, Stearn (1993) also commented on the two genera exhibiting transitional forms in the late Lochkovian Martins Well Limestone Member of north Queensland.

Dong (2001, p. 150), after presenting a similar generic diagnosis of *Atopostroma* to the original diagnosis of Yang & Dong (1979, p. 74), adopted a different approach to classifying the genus. Instead of the earlier Yang & Dong assignment to the "stromatoporids", Dong (2001), perhaps,

after giving greater weight to the presence of long pillars and "connecting rods" forming hexactinellid networks, placed *Atopostroma* in the order Actinostromatida, though his conception of the order remained markedly different from groupings adopted by others (see, for example, Stock, *in Stearn et al.*, 1999). Dong (2001) included the genus *Atopostroma* in the family Gerronostromatidae Bogoyavlenskaya, 1969 along with five other genera, and he also transferred that family to the order Actinostromatida. The genera he included altogether in the family were of mixed affinities—clathrodictyid (*Gerronostroma*, *Pseudoactinodictyon*, *Clathrostroma*), stromatoporellid (*Amnestostroma*), syringostromatid (*Atopostroma*) and problematical (*Pseudostromatopora*)—and none of them, with the possible exception of *Atopostroma*, displays features of the Actinostromatida (see Stock, *in Stearn et al.*, 1999 p. 32). Only *Atopostroma* with its microreticulate microstructure could possibly be interpreted as an actinostromatid (but here it is preferentially treated as a part of the order Syringostromatida). Only approximately half of Dong's (2001) listed genera belong to the family Gerronostromatidae, and that family, according to Nestor (*in Stearn et al.*, 1999, p. 23), belongs to the order Clathrodictyida. All the families of the Clathrodictyida developed a compact skeletal microstructure.

The genus *Atopostroma* has proven to exhibit an original microreticular microstructure, and it only apparently produces a compact or melanospheric (= Dong's "maculae") microstructure when affected by secondary diagenetic processes. Here, we treat the primary skeletal microreticulation as having a primary focus in the classification of genus *Atopostroma*, and therefore the genus is as an indubitable member of the order Syringostromatida. It may have a link to actinostromatids given that some taxa exhibit small-scale structures such as micropillars and microcolliculi, like the genus *Densastroma* Flügel, 1959 (e.g., within the family Densastromatidae Bogoyavlenskaya, 1974), but it is not closely related to a genus like *Actinostroma* that has long pillars with a compact microstructure, as suggested by Dong (2001).

Species of *Atopostroma* are widely distributed in Devonian sequences worldwide: in particular they are reported from the Lower Devonian (Lochkovian) of Arctic Canada and New York, USA (Stearn, 1990; Stock, 1997); in the Lower Devonian (Pragian) of Bohemia, Czech Republic (Pořta, 1894; May, 1999, 2005); in the Lower Devonian (Pragian-Emsian) of eastern Australia (Ripper, 1937; Webby & Zhen, 1993, Webby *et al.*, 1993; and herein); Lower Devonian (Emsian) of Arctic Canada and Yukon (Stearn, 1983; Prosh & Stearn, 1996), and from Guangxi and Sichuan in China (Yang & Dong, 1979; Dong, 2001); as well as from the Middle Devonian of the Kuznetsk Basin, Russia (Yavorsky, 1955), Yunnan, in China (Dong, 2001) and possibly from Afghanistan (Mistiaen, 1985).

[Fig. 3 continued] ... gallery space that grades up into an area defined by a mix of interconnected microreticulate material between small, enclosed spar-filled galleries, and darker, denser, pachystromal layers with a more uniform microreticulation of differentiated micropillars that interconnect to microcolliculi around tiny microgallery spaces towards top, x35; (D) longitudinal section, AM F.134879 (AM FT.15066), showing a acosmoreticular to clinoreticular microstructure, upwardly expanded to hour-glass shaped, superposed pachysteles, and a somewhat irregularly thickened pachystromal layer of microlaminae with the uppermost microlamina usually having the greatest continuity, x35; (E) tangential section, AM F.134882 (AM FT.15073) from the Lomandra Limestone of SD170 section, 274m above the base, x10; F, tangential section, AM F.134879 (AM FT.15067), x10—for detail see Fig. 3C. All scale bars = 1 mm.

Atopostroma distans (Ripper, 1937)

Fig. 3A–F

Not *Actinostroma frustulum* Počta, 1894:145, pl. 18 bis, figs 1–4.—E. Flügel & Flügel-Kahler, 1968:168 (*cum syn.*).—May, 1999:176.—May, 2005:210, 212, 248 (table 26); pl. 25, figs 1a,b, 2a,b; pl. 34 fig. 1a,b, pl. 35, fig. 1; pl. 41, fig. 2a,b.

Actinostroma stellulatum var. *distans* Ripper, 1937:12, pl. 2, figs 1–2.—Ripper, 1938:223, 236, 240.—Teichert & Talent, 1958:16.

?*Actinostroma* cf. *distans* Ripper.—E. Flügel, 1958:180.—H. Flügel, 1961:47.

Actinostroma (*Actinostroma*) *distans* Ripper.—E. Flügel, 1959:142.

Actinostroma stellulatum distans Ripper.—E. Flügel & Flügel-Kahler, 1968:403.

Trupetostroma cf. *ideale* Birkhead.—Stearn & Mehotra, 1970:16, pl. 5, figs 1,2.

Part *Nexilamina dipcreekensis* Mallett, 1971:244, pl. 14, fig. 4 only.

Atopostroma tuntouense Yang & Dong.—Stearn 1983:548, fig. 4E–H.

Not *Atopostroma tuntouense* Yang & Dong.—Stearn, 1990:496, figs 4.1, 4.2, 8.2.

Atopostroma distans (Ripper).—Webby & Zhen, 1993:346, figs 11A–D, 12E.—Webby, Stearn & Zhen, 1993:171, figs 27F, 28A–D.—Prosh & Stearn, 1996:36, pl. 18 fig. 5.

Material. Four specimens, including SD170-210-1 (AM F.134879, AM FT.15066, AM FT.15067), SD170-217-1 (AM F.134880, AM FT.15068, AM FT.15069), SD170-270-3 (AM F.134881, AM FT.15070, AM FT.15071) and SD170-274-3 (AM F.134882, AM FT.15072, AM FT.15073), from 210 m, 217 m, 270 m and 274 m, respectively, above base of Lomandra Limestone (upper Emsian), SD170 section of Mawson *et al.* (1988) in Lomandra Creek type section; and other specimens from C.W. Mallett's collection as follows: UQF.47741, from UQL.2980, 500 m above base of section, Martins Well (MW) traverse, 1 km SW of Martins Well (Mallett, 1971) and UQF.47750, from UQL.2981, 800 m above base of section of MW traverse of Mallett (1971), both from Dip Creek Limestone—note the former specimen was erroneously included in description of *Nexilamina dipcreekensis* by Mallett (1971, p. 244, pl. 14, fig. 4); UQF.47600, from UQL.2974—collected from loose rubble, probably derived from the Chinaman Creek Limestone at South Chinaman Creek, 5 km N of the abandoned Pandanus Creek homestead; two other specimens, respectively, UQF.48243 from UQL.2698, and UQF.48142 apparently comes from the same locality, 2.5 km SSE of Pandanus homestead, with one (UQF.48142) a reworked sample (it came from “isolated rudites” (Mallett, 1971, p. 243), now assigned to the Late Devonian Bulgeri Formation (Lang, 1993); consequently, the other (UQF.48243) is also a reworked specimen.

Description. Skeleton domical, with width and height up to 140 mm; growth surfaces smooth to slightly wavy, but only to extent of forming weak mamelons; growth interruptions define a few, 1 to 3 mm thick, latilaminae, though one specimen (UQF.47741) from the Dip Creek Limestone, SW of Martins Well, has conspicuous latilaminae, 4 to 5 mm thick (Fig. 3B). Astrorhizae moderately well developed, with

centres near tops of mamelons or offset to sides, spaced much closer, 2.5 to 4.5 mm apart, in Broken River material (Fig. 3E), as compared with the holotype (NMV P141754-57, ex MUGD) from the Buchan Caves Limestone of eastern Victoria, with its centres spaced 7 to 9 mm apart; each localized centre has a stellate, outwardly radiating, cluster of up to 12 canals; usually canals are from 0.10 to 0.18 mm wide, and extend laterally within an interlaminar space for a millimetre or more; canals of each cluster are deflected sharply upwards into single, radially aligned, 0.2 to 0.3 mm wide, tabulated, astrorhizal passageway that leads towards growth surface (Fig. 3A).

In longitudinal section pachysteles (pillars where poorly preserved) superposed continuously through many laminae (up to 25 counted) though in a few places continuity much more limited, even locally absent or restricted to only one or two interlaminar spaces; commonly spreading upward, but sometimes more spool- or post-shaped, spaced from 9 to 12 in 2 mm laterally; usually range from 0.08 to 0.20 mm in diameter, but may become more expanded outwardly and upwardly towards top. Pachystromes (or laminae where microreticulation not clearly visible), continuous, of variable thickness (0.05 to 0.18 mm thick), and with spacing from 8 to 12 in 2 mm; sometimes clearly defined by microlaminae at top, from 0.020 to 0.025 mm thick (though in extremes to 0.05 mm thick), and one or two, discontinuous, slightly disordered, rows of microlaminae below, each pair intersected by set of short, pachystele-derived micropillars to form microgalleries, from 0.03 to 0.05 mm in width; in places tiny, darker, melanospheric specks, about 0.01 to 0.02 mm in diameter, visible along microlamina within more-or-less continuous dark line, or may be identified at intersections of microlaminae and micropillars; additionally, in well preserved specimen (SD170-210-1 – AM F.134879), in areas where spool-shaped pachysteles are intersected, rather disordered and disrupted row of microgalleries may develop above a microlamina (Fig. 3D); more commonly, however, skeletal material is less well preserved, with fine structures showing a more diffused compact microstructure, though ghosts of microreticulation may be preserved in form of scattered, vaguely aligned, rows of tiny melanospheric specks. Spar-filled gallery spaces prominent, commonly dome-shaped to vertically ovate or rounded; in some places subdivided by small, low convexity, dissepiments; rarely, longer, wavy, microlamina-like dissepiments occur, and these may act as local pachystromal floors; occasionally pores, about 0.05 mm wide, seen to disrupt continuity of bounding microlaminae. In pachystromal areas microstructure has characteristics of acosmoreticular, whereas in pachysteles microreticulation is irregular, somewhat disordered and slightly divergent, with larger microgalleries reaching 0.05 to 0.07 mm in width; hence these areas include a mix of acosmoreticular and clinoreticular patterns.

In tangential section skeletal framework of pachysteles and pachystromes shows broad differentiation of structural and microreticular elements between successive “interlaminar” layers, broadly divided into three parts (Fig. 3C): near the base the pachysteles appear as rounded to oval, occasionally more elongated to vermiform shapes within extensive, “open”, gallery spaces (and astrorhizae); pachysteles have microreticulate (?acosmoreticular) interiors of subspherical microgalleries, up to 0.04 mm in diameter, and bounded by rod-like microcolliculi and intersected by micropillars;

where pachystele margins are incomplete, the ends of microcolliculi may be frayed; in middle part, pachysteles are more anastomosing to coalesced, with rounded to oval to irregular spar-filled gallery spaces, usually ranging from 0.06 to 0.15 mm in diameter; and inside pachystele walls is well developed acosmoreticular network of microgalleries, from 0.03 to 0.05 mm across; in upper part where pachystromal elements and microlaminae are intersected the microreticulate networks of microgalleries are darker and denser and on average about 0.03 mm in diameter; in small areas where beam-like microcolliculi are not intersected the microgalleries are incomplete or show only aligned rows of tiny rounded micropillars, 0.01 to 0.02 mm in diameter (or sometimes they appear to be preserved as similar-sized melanospheric specks); also in a few places microgalleries arranged in gently meandering patterns, appearing like wall-less microcanals, 0.02 to 0.03 mm wide, and traceable for distances of about 0.4 mm in length (Fig. 3C); the patterns of pachystromal elements with differentiated microlaminae maintain a finely porous, microreticulation, unless skeletons suffer significant diagenetic alteration that seems to cause production of more continuous sheet-like microlaminae.

Remarks. The preservation of one specimen (SD170-210-1 – AM F.134879, see Fig. 3A, C, D, F) of *Atopostroma distans* (Ripper, 1937) from the Lomandra Limestone of the Broken River area is exceptional in exhibiting so much microstructural detail. Described material from all other localities in Australia and elsewhere shows much less well preserved specimens. A close comparison of the holotype and some topotypes of *A. distans* from the Buchan Limestone at Heath's Quarry in Victoria (Ripper, 1937; Webby *et al.*, 1993), has been made recently, in an attempt to reveal more detail about the microstructure. Unfortunately most of this material shows melanospheric, compact, and/or fibrous microstructures, all of which would appear to have developed from secondarily, diagenetic alteration of its original microreticular skeletal elements. Tangential sections of the types were first mentioned by Ripper (1937, p. 13) as having “an appearance which seems to anticipate the porous structure of *Stromatopora* and allied genera”, and Webby *et al.* (1993, p. 171) who reported “cellules” in structural elements of lower, less dense, parts of interlaminar spaces (see also Webby & Zhen, 1993, fig. 12E). The Victorian material in further detailed study shows little direct evidence in both longitudinal and tangential sections of having an original microreticulate skeleton. A number of specimens show discontinuous, single rows of microgalleries between pairs of microlaminae (including the topmost microlamina) and pachysteles (rather than pillars) are identified with disordered (acosmoreticular) and vaguely perpendicular-to-growth microstructures in longitudinal sections of three specimens, including the holotype. Tangential sections of the holotype and another specimen show rounded, to elongate or irregular pachystele outlines with well-defined clusters of microgalleries in their interiors and frayed margins that represent the cut ends of rod-like microcolliculi. These microreticulate structures can all be closely matched with the *A. distans* material studied in the Broken River region. The Victorian types also show matching arrangements of melanospheric dots—patterns such as microlaminae exhibiting a single, discontinuous, parallel-to-growth, row

of melanospheric specks (0.015 to 0.025 mm apart), and less common perpendicular-to-growth rows of dots within pachysteles (or pillars).

The New South Wales Jesse Limestone material of *A. distans* is morphologically similar to the Victorian type and other material, and apparently comes from limestones of more-or-less equivalent, early Emsian age (Webby & Zhen, 1993). Though the specimens come from widely separated localities in south-eastern Australia they exhibit surprisingly few skeletal or preservational differences. Just a few minor differences seemingly exist between them. For example, scattered, small, long-low to more upwardly convex cyst-like dissepiments occur close to bases of “interlaminar” spaces in specimens from both localities; only one significant difference is noted in some Jesse material, particularly one, specimen AM F. 85595 (formerly listed as Sydney University Palaeontology no. SUP97230), that has developed localized, wavy, microlamina-like dissepiments within wider than normal interlaminar spaces (see Webby & Zhen, 1993, fig. 11A). A few Jesse specimens are seemingly less well-preserved, showing a fibrosity that seems to more-or-less mimic traces of an original skeletal microreticulation, shown elsewhere in the same specimens as rows of lighter subspherical voids that possibly represent traces of the original microgalleries.

May (1999, 2005) in a revision of the Devonian stromatoporoids from Bohemia, Czech Republic, designated lectotypes of a number of species, including *Actinostroma frustulum* Počta, 1894 from the Koněprusy Limestone (middle Pragian) near Koněprusy (“hill near Plesivec”). Study of the lectotype of *A. frustulum* and 12 new specimens from western and eastern quarries near Koněprusy (respectively, “Čertovy schody-Zapad” and “Čertovy schody-Vychod”; see May 2002, fig. 1) allowed May (1999, p. 168) to identify the species as having a microreticulate (clinoreticular) microstructure and consequently interpreted *A. frustulum* as a species of the genus *Atopostroma*. Furthermore, on the basis of inferred morphological similarities, May (1999, 2005) proposed *A. distans* (Ripper, 1937) as a junior synonym of *A. frustulum* (Počta, 1894). Stearn (2001, p. 14) initially questioned this interpretation on the basis that the Czech material had not been adequately illustrated but a much more complete documentation (and illustration) of the species has since been made by May (2005). The fuller description and illustrations allow the relationships between the two species to be clarified, and to determine that *A. frustulum* has a markedly different microreticulation. May (1999, 2005, p. 210) recorded a finer clinoreticular network, with microgalleries about 0.015 mm across in *A. frustulum*, whereas the dominant microreticulation in *A. distans* is acosmoreticular, though also clinoreticular in areas where pachysteles expand upwards. In the type material from Victoria (Webby *et al.*, 1993, p. 171) the microgalleries, though previously recorded as ranging from 0.01 to 0.03 mm in diameter, based on a recent reexamination of this material, are far more variable, from 0.01 to 0.05 mm (most commonly 0.03 to 0.04 mm) in diameter.

The second difference is that pachysteles based on the lectotype of *A. frustulum* (see May 2005, pl. 41 fig. 2b) are more slender than is characteristic of *A. distans*. Another example of *A. frustulum* is illustrated by May (2005, pl. 25 fig. 1b) is more comparable but it is not a type specimen. Yet another specimen labelled as *A. frustulum* (illustrated

in tangential section by May (2005, pl. 25 fig. 2b) shows pachysteles that are markedly broader than those exhibited by *A. distans*; indeed this specimen seems to be more closely related to the second described species of *Atopostroma* from Bohemia, *A. contextum* (Počta, 1894)—see May 2005, p. 206, pl. 41 fig. 1b). Consequently, *A. distans* remains a valid and independent species—with its more coarsely acosmoreticular and locally clinoreticular microstructure than the exclusively finely clinoreticular patterns of *A. frustulum* and *A. contextum*, and with its pachysteles that are typically thicker than those of *A. frustulum*, and thinner than those of *A. contextum*.

The better preserved skeletal material of *A. distans* from the Broken River area of Queensland has a typical microreticulation within both pachysteles and pachystromes. The pachystromes are not easy to characterize but intergrade with adjacent pachysteles and may be associated also with sets of closely spaced microlaminae especially towards upper surfaces. It seems that no clear-cut determination of a specific type of microreticulate microstructure (Stock, 1989) can be made for this well preserved species of *A. distans*. All the basic microreticulated structures of the skeleton seem to be acosmoreticular, except where pachysteles diverge upwards and in lower parts of spool-shaped pachysteles where the microreticulation locally converges upward, the condition is clinoreticular, (Fig. 3C).

Atopostroma stearni n.sp.

Fig. 4A–F

Not *Atopostroma tuntouense* Yang & Dong, 1979:74 pl. 41, figs 7, 8.

?*Atopostroma tuntouense* Yang & Dong.—Stearn, 1990:496, figs 4.1, 4.2, 8.2.

Material. Five specimens, including holotype MW6-8 (AM F.134883, AM FT.15074, AM FT. 15075, AM FT.15076) and four paratypes MW1-5 (AM F.134884, AM FT.15077, AM FT.15078 – paratype A), MW20-3 (AM F.134885, AM FT.15079, AM FT.15080 – paratype B), MW20-4 (AM F.134886, AM FT.15081, AM FT.15082, AM FT.15083—paratype C), and MW35-8 (AM F.134887, AM FT.15084, AM FT.15085, AM FT.15086—paratype D), are from the Martins Well Limestone Member of the Shield Creek Formation (late Lochkovian-early Pragian) in the MW section of Mawson *et al.* (1988) near Martins Well; holotype from 6 m above base of MW section, and paratypes, respectively, from 1, 20 and 35 m above base of section, and two additional paratypes, JAL-T/4 (AM F.134888, AM FT.15087, AM FT.15088—paratype F) and JAL-T/6 (AM F.134889, AM FT.15089, AM FT.15090—paratype E), from the upper limestone member of the Jack Formation (earliest Lochkovian) of the Broken River Gorge section are referred to the species. Two less well preserved specimens, JAL-T/3 (AM F.134890, AM FT.15091, AM FT.15092) and JAL-T/17

(AM F.134891, AM FT.15093, AM FT.15094), are from the same horizon and locality.

Derivation of name. After Colin W. Stearn, who has contributed so much to contemporary understanding of Palaeozoic stromatoporoids in general, and to orders Stromatoporoida and Syringostromatida, including the genus *Atopostroma*, in particular.

Diagnosis. Species of *Atopostroma* with pachysteles typically exhibiting upwardly expanding to irregularly post-shaped, and commonly superposed through up to 20 successive pachystromal layers; each pachystrome has a capping of an extended, rather even thin microlamina at top and unevenly suspended microreticular network of pachystrome and associated pachystele elements below; pachystromes variably spaced, about 12 to 17 in 2 mm but usually exhibits two distinctly different successional spacing arrangements, with closely clustered microlaminae, and more widely spaced pachystromal elements, and between these there are elongated, wavy, microlamina-like dissepiments that in places act as raised pachystele floors; microstructure largely acosmoreticular.

Description. Skeleton domical to laminar with dimensions up to 160 mm in height and 260 mm diameter. Growth surfaces smooth, flattened to gently undulating except for a few small, locally upraised, mamelons up to 1 mm high, at least 0.6 mm wide (Fig. 4A); astrophizae most conspicuous in tangential sections, with centres spaced from 3 to 7 mm apart, and including 5 to 8 main, non-tabulated, radiating branches, from 0.10 to 0.20 mm wide (Fig. 4B); most commonly astrorhizal canals located in lower interlaminar spaces but characteristically upturn in places into single, tabulated, longitudinally-orientated, canals that interconnect with astrorhizal centres; sometimes canals are with mamelons. Latilaminae defined by growth interruptions and phase changes, from 1 to 6 mm thick; in one part of holotype an extensive layer of disordered microreticular, dissepiment and canal-like skeletal material, up to 1 mm thick, has developed between successive latilaminae (Fig. 4A, 4E); this layer may represent a kind of basal phase to growth of overlying latilamina.

In longitudinal section skeletal structures dominated by long, thin, even, laterally persistent, microlaminae at tops of pachystromes, and irregularly upward-spreading pachysteles below, these latter commonly superposed but not usually through more than about 12 to maximum of 20 successive “interlaminar” spaces (Fig. 4A, 4D); the single, mainly continuous, microlaminae usually appear as dark, rather dense, plates, about 0.02 mm thick; only rare breaks in continuity occur, that suggest presence of occasional, scattered, small pores, with diameters of 0.02 mm (and perhaps related to original microreticulation). Skeletons show spacing of pachystromes varying widely; on average measurements range from 12 to 17 in 2 mm, though

Fig. 4 [continued from facing page] ... (D) longitudinal section (AM FT.15074), showing characteristic mix of close-spaced pachystromal microlaminae, and more wider spaced microlaminae enclosing the mainly microreticulated superposed, upward-flaring pachysteles, $\times 35$; (E) longitudinal section (AM FT.15074), showing detail of successive growth interruptions and intervening phase of more disorderly arrangement of dissepiments, canal-like tubes and microreticular material, $\times 25$; (F) tangential section (AM FT.15075), showing a well-developed acosmoreticular skeletal network associated with pachysteles, and in denser pachystromal layers including the discrete microlaminae, $\times 35$. All scale bars = 1 mm.

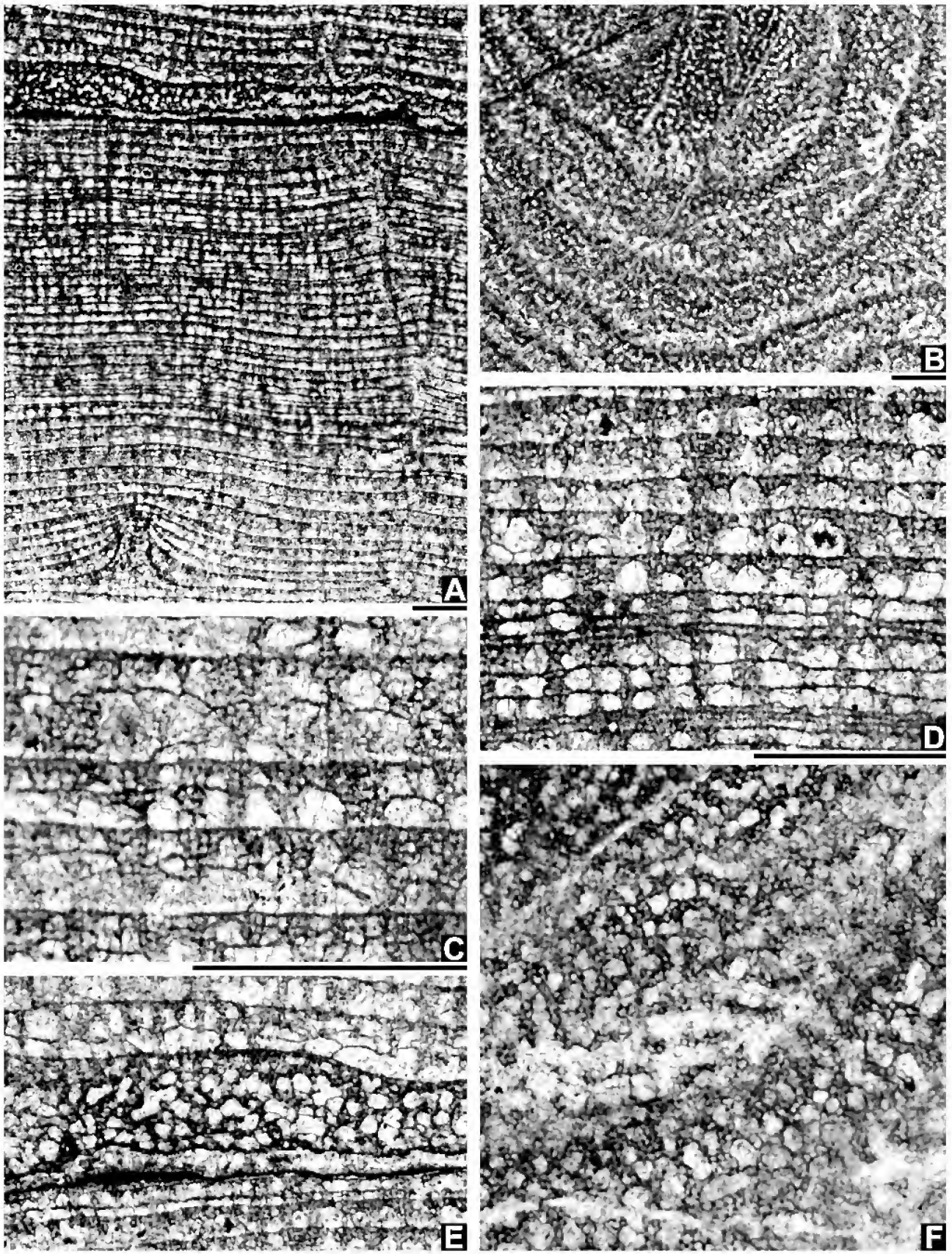


Fig. 4. *Atopostroma stearni* n.sp., A–F, holotype AM F.134883 from Martins Well Limestone Member (Shield Creek Formation), 6 m above the base of the MW section; (A) longitudinal section (AM FT.15074), showing latilaminae with phase changes and a distinctive mamelon, $\times 10$; B, tangential section (AM FT.15075), $\times 10$; (C) longitudinal section (AM FT.15074), showing incomplete microlamina-like dissepiments that intersect interlaminar areas between widely spaced, regular, microlaminae, $\times 50$; ... [continued on facing page]

successively sets of microlaminae are either wide spaced or narrowly spaced; where microlaminae are widely spaced (e.g., 0.15 to 0.35 mm apart), individual “interlaminar” spaces are divisible broadly into two parts, a lower, occupied by gallery spaces, astrorhizae and narrower, ends of the pachysteles, and an upper part represented substantially by spread of pachystele and pachystrome-derived microreticular material that even extends around tops of associated gallery spaces; wavy microlamina-like dissepiments may locally intervene between lower and upper parts, and where present may provide raised floors for development of pachysteles, and may subdivide larger spar-filled galleries into two (Fig. 4C,D). Pachysteles typically expand upwards, from 0.03 to 0.10 mm wide in lower part, to 0.15 mm, even to 0.2 mm wide towards top; and a spacing from 9 to 10 in 2 mm laterally; skeletal material is predominantly acosmoreticular, though at margins of some pachysteles, patterns may be vaguely clinoreticular. Where narrowly spaced, the laterally persistent subparallel to parallel microlaminae occur in sets of two, three or more (Fig. 4D); spaces between microlaminae may be partially occupied by microgalleries containing microcolliculated microlaminae and short micropillars (from 0.02 to 0.04 across), or micropillars are absent or incomplete, appearing as a row of melanospheric dots along a microlamina, about 0.01 mm wide; or these structures may develop a vaguely radial fibrosity possibly where poorly preserved. In addition to undulating microlamina-like dissepiments some small, blister-like dissepiments may be scattered in places within skeleton; they mainly subdivide galleries, especially in lower parts of “interlaminar” spaces; spar-filled galleries characteristically dome-shaped, from 0.10 to 0.20 mm across.

In tangential section, pachysteles rounded to elongated, or irregular, from 0.05 to 0.15 (rarely to 0.20) mm in diameter in “open” gallery areas of lower part of “interlaminar” space; usually pachysteles have frayed margins as result of rod-like, microcolliculi being intersected; pachysteles spread outwards to develop more completely anastomosing network across middle part of “interlaminar” space, including completely enclosed, spar-filled galleries, typically 0.10 to 0.15 mm in diameter (Fig. 4F); microreticular elements acosmoreticular, with microgalleries from 0.025 to 0.050 mm across, and orderly rounded micropillars (0.010 to 0.015 mm across) where microcolliculi intersected. In upper part of “interlaminar” space more uniformly, denser and darker band-like areas (Fig. 4B), that mainly represent parts of obliquely intersected microlaminae near tops of “interlaminar” spaces; finely porous, microreticular network of microgalleries, which are 0.02 mm across (on average); rounded micropillars where they can be differentiated are about 0.01 mm in diameter.

Remarks. The type species, *A. tuntouense* Yang & Dong, 1979, from the Yujiang Formation (Emsian) of South China bears a resemblance to *A. stearni* but its pachysteles are thicker, consequently more widely spaced (6 to 8 in 2 mm), and more regularly superposed, and it lacks any significant development of dissepiments. Material from the Lower Devonian (upper Lochkovian) Stuart Bay Formation of Arctic Canada was first described as *A. tuntouense* by Stearn

(1990, p. 496), but has since been recognized as belonging to a different species from the type species (see Webby *et al.*, 1993) having, for example, a much closer spacing of laminae (16 in 2 mm). This Stuart Bay species, now assigned by Stearn (in press), and illustrated in the *Treatise* volume as “*Atopostroma* n.sp. = *A. tuntouense* of Stearn, 1990, p. 496”, bears close relationships to the late Lochkovian/early Pragian *A. stearni* of the Martins Well Limestone Member in northern Queensland. However though it has a similarity in the spacing of laminae (or pachystromes), the Stuart Bay form shows certain differences that may be of taxonomic importance. Firstly it is described as exhibiting a clinoreticular microstructure, whereas *A. stearni* is dominantly acosmoreticular. Secondly, though it is recorded as having “broadly undulate” microlaminae where they are locally close spaced, the Stuart Bay form does not apparently exhibit the association of more widely spaced microlaminae and intervening wavy microlamina-like dissepiments. Consequently, the Canadian form is only doubtfully regarded as conspecific with *A. stearni*.

Atopostroma stearni also bears close resemblances to *A. distans* (Ripper, 1937) from the Early Devonian (Emsian) successions of Victoria (Webby *et al.*, 1993), central New South Wales (Webby & Zhen, 1993), and North Queensland (herein), but differs mainly in having on average more closely spaced pachystromes (or laminae), from 12 to 17 in 2 mm, compared with spacing of pachystromes (or laminae), from 7 to 11 in 2 mm in *A. distans*, and *A. stearni* more commonly exhibits dissepiments both long, wavy microlamina-like and small cyst-like types. Also, in *A. distans*, pachysteles may be spool-shaped with the microreticulation, not only typically diverging upwards, but also, locally, converging in the lower parts of pachysteles, a feature not seen in *A. stearni*, and the pachysteles are more markedly superposed in *A. distans* than in *A. stearni*.

Atopostroma sp. 1 from the Dayville Member of the Coeymans Formation (Lochkovian) in New York (Stock, 1997) is another possibly related form, though its pachysteles are slightly thicker than in *A. stearni*, and no long, wavy, dissepiments occur; consequently Stock’s *Atopostroma* sp. 1 is not conspecific with *A. stearni*. A second species recorded by Stock (1997) as *Atopostroma* sp. 2 from Deansboro Member of the Coeymans Formation is likely to belong to another syringostromatid genus, possibly *Coenostroma* Winchell, 1867.

Somewhat transitional relationships exist between species of *Atopostroma* such as *A. stearni*, and species of *Habrostroma*, not only in the Martins Well Limestone Member. For example, the microreticulation is similar, that is, mainly acosmoreticular, in both genera *Atopostroma* (herein), and *Habrostroma* (Stock, 1991, p. 903). Secondly, the pachysteles of *A. stearni* are less continuous and regularly superposed than in some other species of *Atopostroma*, whereas though typically species of *Habrostroma* have short pachysteles, some do have superposed pachysteles not unlike *A. stearni*. For example, the Lochkovian species *Habrostroma microporum* and *H. centrotum* (see Stock, 1991, 1997, figs 4–7) exhibit superposed pachysteles, and like *A. stearni* commonly exhibit long, wavy, microlamina-like dissepiments.

Atopostroma protentum n.sp.

Fig. 5A–G

Material. Eleven specimens, including holotype MW1-1 (AM F.134892, AM FT.15095, AM FT.15096), and ten paratypes MW1-20 (AM F.134893, AM FT.15097, AM FT.15098—paratype A), MW6-4 (AM F.134894, AM FT.15099, AM FT.15100—paratype B), MW6-6 (AM F.134895, AM FT.15101, AM FT.15102—paratype C), MW6-7 (AM F.134896, AM FT.15103, AM FT.15104—paratype D), MW6-9 (AM F.134897, AM FT.15105, AM FT.15106—paratype E), MW6-10 (AM F.134898, AM FT.15107, AM FT.15108, AM FT.15109—paratype F), MW6-11 (AM F.134899, AM FT.15110, AM FT.15111—paratype G), MW6-12 (AM F.134900, AM FT.15112, AM FT.15113—paratype H), MW6-13 (AM F.134901, AM FT.15114, AM FT.15115—paratype I) and MW6-20 (AM F.134902, AM FT.15116, AM FT.15117—paratype J), from the Martins Well Limestone Member, Shield Creek Formation of the MW section of Mawson *et al.* (1988) near Martins Well; holotype from 1 m above base of MW section, and paratypes, respectively, from 1, 6, and 20 m above base of section. Two other specimens, MW1-18 (AM F.134903, AM FT.15118, AM FT.15119), and MW35-9 (AM F.134904, AM FT.15120, AM FT.15121) are included in the species, and doubtfully, MW1-9 (AM F.134905, AM FT.15122, AM FT.15123), MW1-17 (AM F.134906, AM FT.15124, AM FT.15125) and MW6-18 (AM F.134907, AM FT.15126, AM FT.15127); these all come from the same horizon and locality as the type material, respectively, from 1 m, 6 m and 35 m above base of section. Three of the specimens [MW6-6 and MW6-7 (AM F.134896—paratype C, and AM F.124896—paratype D), and specimen MW1-18 (AM F.134903)] are intergrown with an unnamed cyanobacterium.

Derivation of name: Latin, *protentum*, stretched out, lengthened—alluding to the dominantly wide-spaced microlaminae.

Diagnosis. Species of *Atopostroma* with pachysteles typically exhibiting upwardly expanding to irregular, even locally, spool to post-like, shapes, and may be superposed through up to 12 successive pachystromal layers; each pachystrome has capping of laterally continuous, gently undulating, thin microlamina at top, and unevenly suspended microreticular network beneath, composed of pachystromal and associated pachystele elements; spacing of pachystromes varies from 5 to 11 (usually 7 to 8) in 2 mm, that is, they are relatively widely spaced, and commonly they have intervening, thin, wavy, microlamina-like dissepiments that act as raised pachystele floors; microstructure dominantly acosmoreticular.

Description. Skeleton laminar to domical, with maximum height of 110 mm and maximum diameter of 220 mm. Growth surfaces smooth to slightly wavy, rarely showing small mamelons. Latilaminae apparently absent, but a few discontinuity surfaces preserved. Astrorhizae conspicuous in skeletons, especially well shown in tangential sections (Fig. 5B), with individual stellate clusters centred between 4 and 10 mm apart; centres connect to vertical astrorhizal canal, 0.2 mm across; each centre has up to 10 outwardly radiating and branching astrorhizal canals, from 0.1 to 0.2 mm wide; no

tabulae associated. Small, updomed, mamelonate structures, possibly related to astrorhizal system, are 1 mm high and 0.5 mm wide.

Caunopore tubes commonly associated in stromatoporoid skeletons, as intergrown, phaceloid (longitudinally aligned) and tabulated corallites of coral *Syringopora*; corallites vary from 0.3 to 1 mm (usually 0.7 to 0.8 mm) in diameter, and typically show tabulae with infundibuliform floors and/or axial syrinxes (Fig. 5A,B); also in a few places tabulate coral exhibits lateral branching. Microlaminae of stromatoporoid characteristically downflexed slightly at intersections with caunopore tubes. Small, solitary rugosan, about 1.0 to 1.7 mm in diameter, also intergrown in places, and helicoid spiralling “worm tubes” (*Helicosalpinx*) with diameter of 0.9 to 1.0 mm. In addition, in localized areas of some stromatoporoid skeletons, especially close to, or along, discontinuity surfaces (perhaps associated with intervals of slowing, or cessation, of stromatoporoid growth) an undescribed, problematical, cyanobacterium occurs as upright dendroid growths of dark, thread-like tubules (Fig. 5F) that may be partitioned into “cellules”, 0.02 to 0.035 mm across, to maximum width of 0.05 mm; as well as various parallel-to-growth aspects—where threads may appear like strings of beads and as clusters on surfaces adjacent to, or within individual microlamina; at points of lateral budding a noticeable tendency occurs for chainlike row of “cellules” to increase rapidly in size; colonization by this microorganism is typically within the microreticulate networks of pachysteles and within some porous microlaminae.

Stromatoporoid skeleton exhibits prominent, evenly spaced, laterally continuous, flattened to gently undulating, and relatively thin, microlaminae; most commonly a single, microlamina occurs, but locally in a few places may divide into two, but rarely continues in a closely paired relationship, even laterally may merge into a single microlamina again; in addition localized, thin, compact, undulating, microlamina-like dissepiments occur, but typically these occur towards middle of more widely spaced “interlaminar” spaces (where successive microlaminae are spaced between 0.25 and 0.95 mm apart); these microlamina-like dissepiments have comparatively limited lateral continuity; also smaller, irregular, low convexity and obliquely aligned, dissepiments (like normal cyst plates) may occur, usually in lower part of “interlaminar” space. Microlaminae usually have a variable thickness (0.01 to 0.03 mm thick) and appear to have compact microstructure but some show a mid-line row of tiny, darker (?melanospheric) dots, about 0.035 mm apart, or in other places are vaguely microreticulated; also breaks in continuity of microlaminae occur in places suggesting small pores, 0.02 to 0.025 mm across; a few other pores are larger, to 0.05 mm across; spacing of microlaminae ranges from 5 to 11 in 2 mm (most commonly 7 to 8 in 2 mm).

Pachysteles are from 0.06 to 0.20 mm in diameter near base, and characteristically spread upward and outward, and enclose irregular microreticular network, coalescing against undersurfaces of overlying microlaminae; however, much irregularity exists in pachystele shapes (Fig. 5G), with some more spool- or post-like, or may be less well developed in certain areas, for example, where microlaminae are close spaced, less than 0.1 or 0.2 mm apart; or where they are more widely spaced, pachysteles may be incompletely developed below middle parts of “interlaminar” space, being replaced by spar-filled areas (galleries, astrorhizal

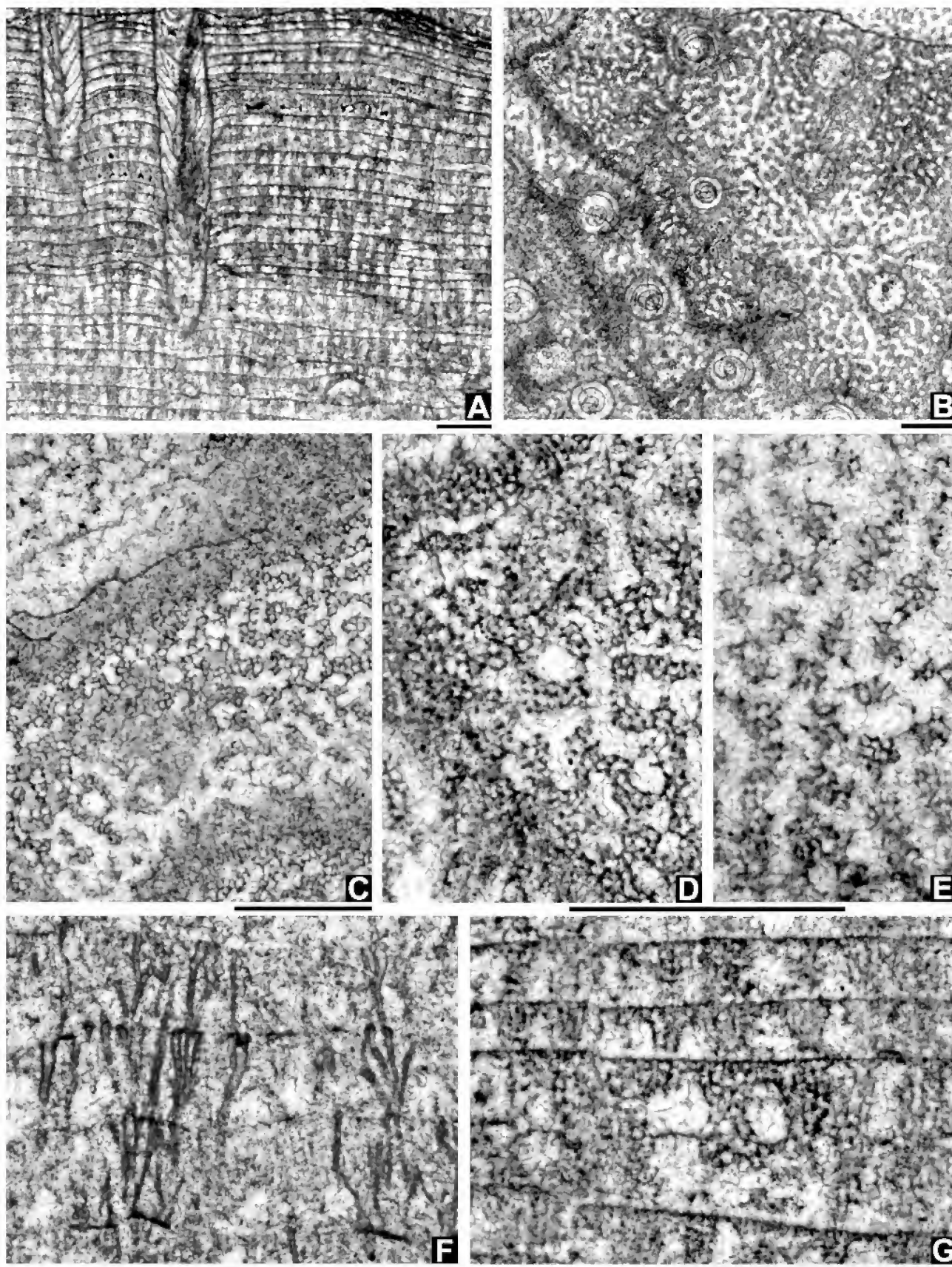


Fig. 5. *Atopostroma protentum* n.sp., A, B, D, G, holotype AM F.134892 from Martins Well Limestone Member (Shield Creek Formation), 1 m above base of MW section; (A, B), longitudinal (AM FT.15095) and tangential (AM FT.15096) sections, showing astrorhizae and associated caunopore tubes, $\times 10$; (C, E), tangential sections of paratype E, AM F.134897 (AM FT.15100), from Martins Well Limestone Member, 6 m above base of MW section; (C), showing characteristic morphological ... [continued on facing page]

structures) or may be separated by floors formed by dissepiments; most typically, however, pachysteles are regularly superposed (rarely branching) through up to 15 successive microlaminae, i.e., for distances of up to 3.5 mm, and have spacing ranging from 6 to 9 in 2 mm laterally. Microreticulation of pachysteles shown by slightly inclined upward and outward rows of micropillars and microcolliculi that define microgalleries; variation in sizes and shapes of microgalleries suggest irregular, acosmoreticular microstructure; usually microgalleries range from about 0.03 to 0.04 mm, rarely to 0.05 mm across; sometimes aligned rows of tiny melanospheric dots occur, possibly representing points where micropillars and microcolliculi intersected in their original state prior to diagenetic alteration. Between pachysteles, spar-filled gallery spaces tend to be upwardly elongated and slightly narrowing, about 0.1 to 0.2 mm across, with domelike tops in contact with upper microlaminae, and typically divided in two by a thin, wavy microlamina-like dissepiment; in these areas microlaminae do not exhibit larger pores but microreticular-sized pores may have existed but no longer clearly preserved in longitudinal sections.

In tangential section, lower parts of “interlaminar” spaces show isolated, rounded to irregular pachysteles from 0.15 to 0.2 mm in diameter within open spar-filled gallery spaces (Fig. 5C,E), and these grade into more elongate to vermicular pachystele shapes a little higher up within more sinuous gallery spaces, some of which probably represent traces of astrorhizal canals (Fig. 5D); pachystele margins in these lower-middle parts of “interlaminar” space are typically frayed (Fig. 5E), due to cut ends of beam-like microcolliculi; microgalleries vary from 0.03 to 0.05 mm across, and from shapes of microgalleries are evidence of acosmoreticular microstructure. In upper parts of “interlaminar” spaces, pachysteles become more coalesced though small, rounded spar-filled gallery spaces remain in places, from 0.10 to 0.15 mm in diameter. Closer to upper microlamina, skeletal material is almost entirely microreticulate, composed of rounded micropillars, 0.02 mm in diameter, and very fine rod-like microcolliculi, 0.007 mm thick, that define microgallery margins, typically 0.03 to 0.04 mm across. A gradational change occurs into darker, and more densely, microreticulated areas of upper microlamina, though microgallery dimensions remain much the same (Fig. 5D); also in a few places microgalleries seem to have become aligned and interconnected in arrangements that appear like slightly sinuous, very fine, tubule-like, pathways; however, in some, rather more dense and diffused areas the primary microreticulation of a microlamina has become

rather obscure (Fig. 5C), possibly owing to its diagenetic alteration into a more continuous, solid sheet with scattered dark ?melanospheric specks.

Remarks. *Atopostroma protentum*, though it bears close similarities to the type species *A. tuntouense* Yang & Dong, 1979 from the early Emsian of South China, especially in the spacing of tangentially directed structural elements (called “laminae” in the type species but appearing more like microlaminae), but exhibits differences in the longitudinally orientated elements (called “pillars” in the type species) with thicker, slightly wider spaced, and more continuously superposed structures than in the equivalent pachysteles of *A. protentum* n.sp. The present material is also comparable with the type material of *A. distans* (Ripper, 1937) from the Buchan Caves Limestone of Victoria (Webby *et al.*, 1993), material from the Jesse Limestone of New South Wales (Webby & Zhen, 1993), and also, as described from the Broken River area, herein, but *A. protentum* n.sp. as described here has slightly coarser, though less continuously superposed longitudinal structural elements; the pachystele spacing is from 6 to 8 in 2 mm in *A. protentum*, whereas in the Victorian type material of *A. distans* it is 8 to 9 in 2 mm; also dissepiments are comparatively uncommon in *A. distans*, and certainly none of the longer, microlamina-like dissepiments present in *A. protentum*. In addition the tangential structural elements of *A. protentum* are comparatively thinner (composed mainly of microlaminae) and more widely spaced, whereas the “laminae” of the Victorian type specimens of *A. distans* are relatively thicker and more closely spaced.

Comparisons with *A. stearni* n.sp. are also warranted especially as both *A. stearni* and *A. protentum* come from the same locality and horizon in the Martins Well section. The two species have many structural microstructural similarities, but *A. stearni* exhibits markedly different successional patterns of spacing of microlaminae; first, a closely spaced phase that includes a very limited development of pachystele structural elements, only some very short, rather scattered, micropillars; and secondly, a wide-spaced phase that includes a full range of longitudinally orientated features, such as upward-flaring pachysteles with acosmoreticular microstructure, and wavy, microlamina-like dissepiments. Examples of the close-spaced phase with sets of up to four microlaminae occur at irregular intervals through the skeleton. In contrast, *A. protentum* is dominantly composed of the wide-spaced phase of development—it mainly lacks developments of clustered close-spaced microlaminae. Also

Fig. 5 [continued from facing page] ... succession (and microreticulation) across one interlaminar area (AM FT.15106), with sharp contact between dense, more diffused and coalesced, pachystromal layer and “open”, irregularly rounded, pachystele profiles at base (see also Fig. 5E), then grading successively into an interconnected, anastomosing pachystele meshworks of middle to upper parts, and then into the next dense and diffused pachystromal layer at the top, $\times 25$; (D) tangential section of holotype (AM FT.15096) showing in greater detail the nature of the acosmoreticular microstructure in both more open, anastomosing pachystele network areas and darker, more diffused and dense pachystromal (or microlaminar)—in both areas dark, rounded, micropillars and interconnected microcolliculi are visible defining the microgalleries, $\times 50$; (E) tangential section of paratype E (AM FT.15106), showing detail of irregularly rounded, internally microreticulated pachystele profiles, and the frayed spine-like margins where ends of the beam-like microcolliculi have been intersected in tangential section, $\times 50$; (F) longitudinal section of paratype C, AM F.134895 (AM FT.15101), also from 6 m above base of MW section, showing the presence of a dendroid intergrowth of dark thread-like filaments that are internally differentiated into single rows of cells—it probably represents a new, as yet unnamed, cyanobacterium that infested parts of the microreticulate skeleton, spreading upwards and budding regularly longitudinally within the pachystele microgallery meshwork as well as becoming locally concentrated tangentially within successive pachystromal microgallery spaces, $\times 50$; (G) longitudinal section of holotype (AM FT.15095) shows pachysteles with well defined acosmoreticular to clinoreticular microstructure and the pachystromes are represented by dark, laterally persistent, regular microlaminae—they rarely show breaks in continuity, $\times 50$. All scale bars = 1 mm.

overall, *A. stearni* exhibits a closer spacing of pachystromes, on average between 12 and 17 in 2 mm, compared with *A. protentum* that shows a spacing of pachystromes, averaging between 7 and 8 in 2 mm.

Habrostroma Fagerstrom, 1982

Type species. *Stromatopora proxilaminata* Fagerstrom, 1961.

Discussion. In the type species of *Habrostroma*, *H. proxilaminatum* (Fagerstrom, 1961), Prosh & Stearn (1996, p. 36) described the pachystele microstructure as “orthoreticular to clinoreticular” in longitudinal section, and as having a “cellular (=irregular microreticular)” microstructure, presumably the “acosmoreticular” type of Stock (1989) in tangential section. However, other writers have recognized the genus *Habrostroma* as exhibiting only acosmoreticular microstructure (see Stock, 1991, 1997; Webby *et al.*, 1993). For comparative purposes, the genus *Atopostroma*, based on *A. tuntouense* Yang & Dong, 1979, has been described as exhibiting “orthoreticulate to clinoreticulate” microstructure (see Stearn, 1993, Stearn *et al.*, 1999), but also in Stearn (1990, p. 498) and Stock (1997, p. 549), as only exhibiting a clinoreticular type of microstructure, as in *Columnostroma* and *Coenostroma*, respectively. In the present study, the species of *Atopostroma* show examples of both acosmoreticular and clinoreticular microstructural types; no orthoreticular types have been found.

The diagnostic features of the two genera are as follows: *Habrostroma* typically has pachysteles that are shorter, more irregular, confined largely within “interlaminar” spaces (rarely superposed) and internally composed of an irregular network of acosmoreticular skeletal material; and the pachystromes prominent but not thick, with one or more microlaminae, and sometimes microlamina-like dissepiments. *Atopostroma*, on the other hand, has pachysteles that are typically superposed, formed by upward and outward accretion to produce irregularly spread network of acosmoreticular to clinoreticulate skeletal material beneath successive, laterally extensive, microlaminae. The two described species *H. alternum* and *A. protentum* occur together in the Martins Well Limestone Member and are truly transitional forms, showing some features characteristic of each genus. Some consideration has been given to combining them, even treating them as different species of the one genus. However, between the mid-range and extremes of variation of the two species they are clearly representatives of different genera.

Habrostroma alternum n.sp.

Fig. 6A–F

Material. Six specimens including holotype MW6-3 (AM F.134908, AM FT.15128, AM FT.15129), and five paratypes MW1-2 (AM F.134909, AM FT.15130, AM FT.15131—paratype A), MW1-6 (AM F.134910, AM FT.15132, AM FT.15133—paratype B), MW1-12 (AM F.134911, AM FT.15134, AM FT.15135—paratype C), MW6-5 (AM F.134912, AM FT.15136, AM FT.15137—paratype D) and MW6-15 (AM F.134913, AM FT.15138, AM FT.15139—paratype E), from Martins Well Limestone Member, Shield Creek Formation (late Lochkovian-early Pragian) of the MW section of Mawson *et al.* (1988) near Martins Well; holotype as well as paratypes D and E are from 6 m above base of MW section, and the other paratypes, are from 1 m above base of section. Five other specimens MW1-3 (AM F.134914, AM FT.15140, AM FT.15141), MW1-8 (AM F.134915, AM FT.15142, AM FT.15143), MW1-19 (AM F.134916, AM FT.15144, AM FT.15145), MW6-19 (AM F.134917, AM FT.15146, AM FT.15147) and MW6-21 (AM F.134918, AM FT.15148, AM FT.15149) from the same locality, with the first three listed specimens from 1 m above base, and the last two, from 6 m above base of section.

Derivation of name: Latin, *alternum*, other—relating to the transitional relationships that exist between this taxon and *Atopostroma protentum* n.sp.

Diagnosis. A species of *Habrostroma* with pachysteles relatively short, mainly irregular but sometimes tending to be somewhat upwardly expanded; not usually superposed (and continuous) through more than about five successive pachystromes though more extended local alignments exist, but the related pachysteles are usually incomplete structures, that do not cross entirely each successive pachystrome; pachystromes are spaced moderately widely, from 5 to 14 in 2 mm (usually 8 to 9 in 2 mm); each has a prominent, extensive, thin, gently undulating, microlamina at top, and has irregular microreticular meshwork, including complete and incomplete pachysteles immediately below; between successive pachystromes, laterally extensive patterns of thin, wavy, microlamina-like dissepiments are commonly developed and often act as pachystele floors; microstructure acosmoreticular.

Description. Skeleton is domical with growth surfaces smooth to broadly undulate; latilaminae rarely seen, but discontinuity surfaces occur (Fig. 6A). Caunopore tubes of syringoporiid tabulate coral affinity commonly seen in intergrowth relationships (Fig. 6B,C,E); characteristically coral has deeply concave tabulae, and corallites usually have larger (0.7 to 0.85 mm) or smaller (0.3 to 0.55 mm) diameters; and in a few places lateral buds seen in smaller

Fig. 6 [continued from facing page] ... well defined more densely microreticulated microlaminae—also astrorhizal canals are conspicuous and caunopore tubes of two markedly different diameters occur, $\times 25$; (D) tangential section of paratype A, AM F.134909 (AM FT.15130), from the Martins Well Limestone Member (Shield Creek Formation), 1 m above base of MW section, showing acosmoreticular patterns of microstructure with locally well developed rounded micropillars and thin, beam-like microcolliculi, $\times 35$; (E) longitudinal section of holotype (AM FT.15128), showing pachysteles that are acosmoreticular, mainly confined within interlaminar spaces (rarely superposed) and have long, cyst-like interlaminar dissepiments, $\times 25$; (F) longitudinal section of holotype (AM FT.15128), showing greater detail with postlike to downward tapering pachysteles that tend to be confined to middle-upper parts of interlaminar spaces, even sometimes appearing to have their floors disrupted or commencing on the tops of the long, wavy, cystlike dissepiments, $\times 50$. All scale bars = 1 mm.

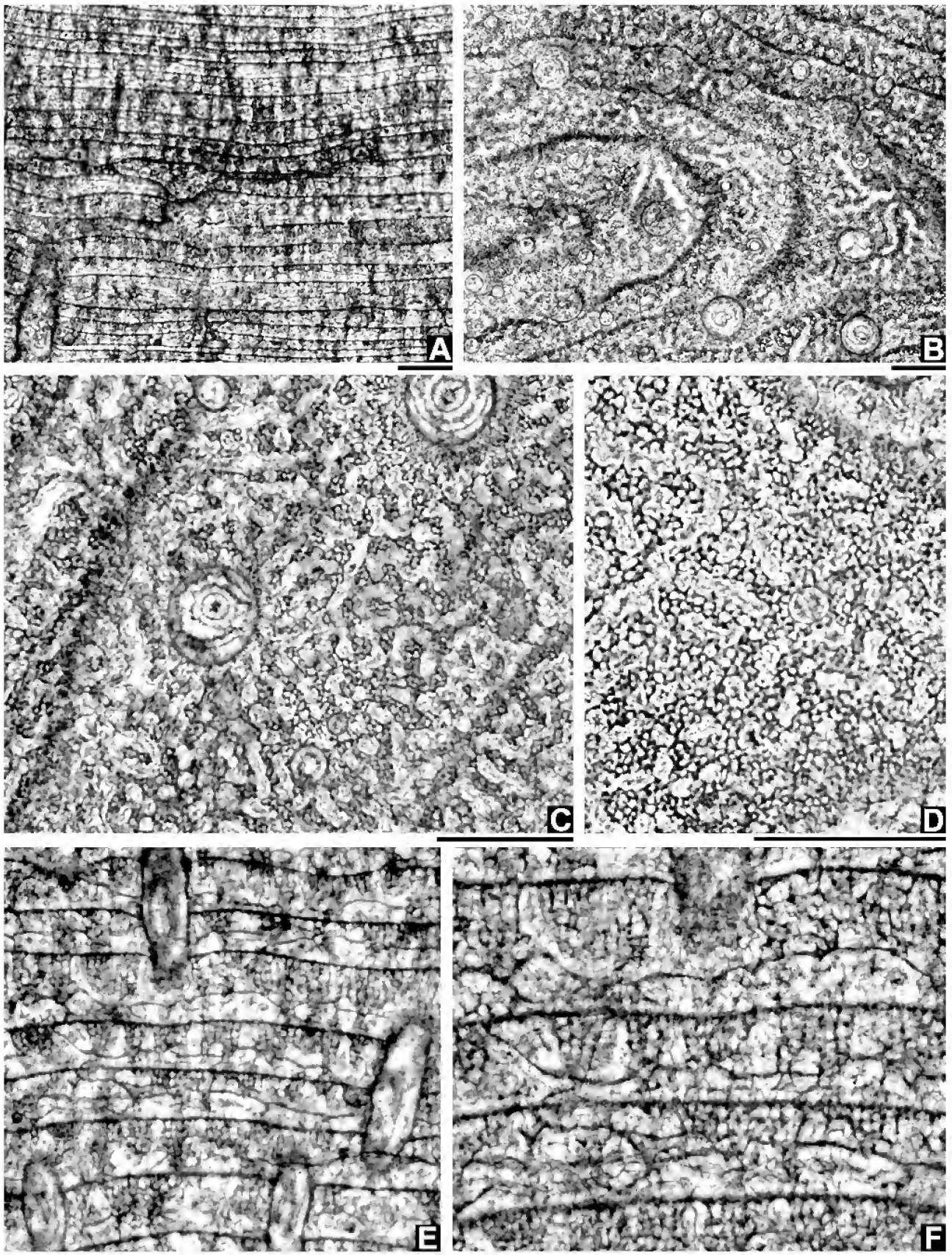


Fig. 6. *Habrostroma alternum* n.sp., A–C, E, F, holotype AM F.134908 from Martins Well Limestone Member (Shield Creek Formation), 6 m above base of MW section; (A) longitudinal section (AM FT.15128), $\times 10$; (B) tangential section (AM FT.15129), $\times 10$; (C) tangential section of holotype (AM FT.15129), showing nature of morphology and microreticulation across one interlaminar area, of mainly interconnected anastomosing acosmoreticular pachystele meshworks between the successive, narrow, ... [continued on facing page]

corallites; also rare solitary rugosans, and possibly a 0.3 to 0.4 mm diameter worm tube (possibly *Helicosalpinx*) occur. Astrorhizae only conspicuous in tangential section (Fig. 6B,C) forming localized stellate clusters of irregularly radiating and branching astrorhizal canals, spaced from 4 to 9 mm apart; and individual astrorhizal canals from 0.01 to 0.02 mm wide; in a few places, one or more converge into a single, untabulated, vertical canal, 0.02 to 0.03 mm in diameter, and sometimes associated with small mamelons, 0.5 mm wide and 0.8 mm high.

Single, thin, dark, laterally continuous, flattened to weakly undulate microlaminae are most conspicuous skeletal elements in longitudinal section; where in contact with caunopore tubes microlaminae almost always gently downflexed; only in a few places are close-spaced, second or third microlaminae seen to split off (or coalesce with) a microlamina; widest spacing between successive microlaminae is 0.6 mm; spacing more usually about 0.25 mm; spacing of microlaminae on average between 8 to 9 in 2 mm; spacing extremes range from 5 to 14 in 2 mm; microlaminae typically 0.025 mm thick and where a close-spaced pair of microlaminae develop they may be accompanied by traces of short micropillars, defining a row of microgalleries, each about 0.03 to 0.05 mm across; also a few small pores (foramina) may interrupt lateral continuity of microlaminae, from 0.07 to 0.15 mm in diameter.

Overall pachysteles rather short, irregular and not commonly radially aligned through skeleton; may extend across "interlaminar" spaces, as irregularly post-like or tapering downward structures, but are sometimes shorter, confined to upper two-thirds of "interlaminar" space (Fig. 6E,F); lower part is represented by poorly differentiated, spar-filled areas of galleries, astrorhizae and/or allotubes; in places where superposed, pachysteles occur they only extend for short distances to about 2 mm longitudinally; pachysteles are prominently microreticulate (largely acosmoreticular), and they are consistently spaced from 7 to 9 in 2 mm; individually pachystele dimensions are from 0.10 to 0.05 mm wide in lower part of interlaminar space to up to 0.25 mm wide in upper part; microgalleries are of irregular shape and size, with alignment of rows appearing to be orientated directly upward near axes of pachysteles but more splayed upward and outward towards pachystele margins.

"Interlaminar" spaces, especially in lower two-thirds, commonly exhibit small, thin, oblique to convex upward vesicle-like dissepiments, and more extended, undulating, microlamina-like dissepiments (Fig. 6E,F), that subdivide spar-filled gallery spaces and sometimes are also continuous through pachysteles; at tops the subdivided gallery spaces have dome-shaped outline, and usually 0.1 to 0.2 (rarely to 0.3) mm wide; they may extend up to overlying microlamina but are sometimes separated immediately beneath by a thin laterally spreading veneer of microreticulated skeletal material.

In tangential section towards the base, pachysteles composed of microreticulate skeletal material within rounded to irregular profiles, ranging from 0.05 to 0.20 mm in diameter (Fig. 6C,D); pachysteles tend to show frayed margins where beam-like microcolliculi are intersected; astrorhizal canals seem to mainly occupy more open vermiform areas; pachysteles coalesce into more completely closed networks towards tops; microlaminae are represented by darker, dense, rather diffused layers that still seem to show

many differentiated microgalleries.

In general microstructure is coarsely ascosome-like (Fig. 6C–F), with networks of irregular microgalleries, only crudely arranged in longitudinal and tangential rows, and ranging in most areas from 0.05 to 0.075 mm across, but may be smaller, down to 0.035 mm across, or exceptionally in places up to 0.1 or 0.15 mm across; micropillars rounded, about 0.01 mm in diameter, and may be from 0.02 to 0.03 mm apart in areas where more enclosed networks occur; in less well preserved areas appear to be replaced by darker melanospheric specks; areas of intersected microlaminae exhibit a finer microreticulation of microgalleries, usually about 0.025 mm in diameter.

Remarks: *Habrostroma alternum* shows features that are transitional to typical *A. contentum* but remains confidently referable to *Habrostroma*. It differs in exhibiting shorter and more irregular pachysteles and localized undulating microlamina-like dissepiments, though some characteristics of *Atopostroma* are also shown, such as the superposition (only partial) of pachysteles, and tendency for pachystele skeletal material to upwardly and outwardly veneer undersurfaces of successive microlaminae. *Habrostroma alternum* has little close resemblance to other known species of *Habrostroma* from Lower Devonian successions. In comparison with *H. tyersense* Webby, Stearn & Zhen, 1993 from the Pragian Cooper Creek Limestone and equivalents of Victoria, the Broken River species has pachystromes composed mainly of single microlaminae at tops of "interlaminar" spaces, rather than paired or multiple microlaminae with associated rows of microgalleries as in *H. tyersense*, and it also differs in having coarser and more widely spaced pachysteles as well as localized, microlamina-like dissepiments. *Habrostroma centrotum* (Girty, 1895) from the Manlius and Coeymans formations (Lochkovian) of New York (USA) as revised by Stock (1991, 1997) also exhibits some similarities, such as the presence of some localized, undulating, microlamina-like dissepiments, but pachysteles in *H. centrotum* are more continuously superposed and their laminae (or pachystromes) are more closely spaced. Another species, previously referred to as *Habrostroma* sp., from the Jesse Limestone (Emsian) of central-western New South Wales (Webby & Zhen, 1993), is probably closer to *Parallelopora* Bargatzky, 1881, than to *Habrostroma*.

Columnostroma Bogoyavlenskaya, 1972

Type species. *Coenostroma ristigouchense* Spencer, 1884, p. 599.

Columnostroma sp.

Fig. 7A–C

Material. Available material is fragmentary and recrystallized, comprising two specimens, SD260-11-3 (AM F.134919, AM FT.15150, AM FT.15151) and SD260-11-4 (AM F.134920, AM FT.15152, AM FT.15153, AM FT.15154), from 11 m above the base of the Dosey Limestone in SD260 section of Sloan *et al.* (1995), 2 km NNW of Storm Hill; the latter specimen is somewhat better preserved.

Description. Skeleton laminar to weakly mamelonate and latilaminar; dominated by long, thickened and radially aligned pachysteles, 0.2 to 0.35 mm across, with spacing from 3 to 5 in 2 mm; commonly they are close spaced, and often in contact, but rarely seen to merge or branch; because of alteration, pachysteles are preserved mainly as compact, dense, rod-like elements, but a few aligned dark melanospheric dots are preserved confirming an incomplete microreticulation of micropillars and microlaminae, from 0.02 to 0.03 mm thick, defining subrounded microgalleries about 0.04 to 0.05 mm in diameter. Pachystromes are irregularly developed between pachysteles; they may be represented as thicker pachystromal extensions about 5 mm in length and up to 0.2 mm in thickness, but in other areas represented by short lengths of a poorly differentiated network that may include one or more microlaminae; they may be inconsistently aligned laterally, and much interrupted by intervening allotubes. Typically allotubes are elongated to rather irregular, and divided by slightly domal to obliquely aligned dissepiments, at intervals of 10 to 15 in 2 mm longitudinally; in tangential section allotubes are small and circular in outline, about 0.2 mm in diameter. Astrorhizal canals may be centred in broad mamelons, their branches extend tangentially through other parts of skeleton; some exhibit tabulae from 0.2 to 0.4 mm apart.

Remarks. The Broken River species should probably be assigned to the genus *Columnostroma* on the basis of its long, stout, rounded, close-spaced pachysteles, less important pachystromes and traces of a fine reticular microstructure, though the particular type of microreticulation, *sensu* Stock (1989), cannot be ascertained. However, owing to the incompleteness of available material and poor preservation overall, the species must be left in open nomenclature. The type species of *Columnostroma*, *C. ristigouchense* (Spencer, 1884) from the Early Devonian of New Brunswick, Canada, shows some resemblances, having rather similar overall dimensions, but the pachysteles of the Broken River species are slightly thicker and more closely spaced, and the laminae within pachystromal segments are not demonstrably colliculate. Only one Australian species of *Columnostroma*, *C. clathratum* Webby, Stearn & Zhen, 1993 has been described previously from the Pragian Lilydale Limestone of Victoria, and this bears little resemblance to the Broken River species, being much finer in overall skeletal structure, and the pachystromes more regular, continuous, and fine-textured, with microlaminae mainly in conformity with the horizontal dissepiments crossing the allotubes.

Family Parallelostromatidae

Bogoyavlenskaya, 1984

Parallelopora Bargatzky, 1881

Type species. *Parallelopora ostiolata* Bargatzky, 1881.

Parallelopora sp.

Fig. 7D,E

Material. Two specimens, UQF.47983 and UQF.47979, both from UQL.2974 in reworked pebbles of the Chinaman Creek Limestone (Broken River Group), South Chinaman Creek, north of abandoned Pandanus Creek Station (material collected by C.W. Mallett in the late 1960s).

Description. Skeleton dominantly of long, continuous, thickened, pachysteles composed of coarsely microreticulated material, and successive, moderately close-spaced and laterally extended, thin microlaminae; pachysteles usually from 0.25 to 0.35 mm thick in areas where allotubes or other gallery spaces are well developed, and typically spaced from 3 to 4 in 2 mm; adjacent pachysteles sometimes merge locally or branch, where no gallery spaces intervene as pachystromal intervals; up to 2.5 mm long and 0.025 mm thick but such relationships do not normally maintain marked longitudinal continuity. Flattened to gently undulant microlaminae are apparently diagenetic derivatives of regularly aligned microcolliculi, and have lateral continuity over distances of 6 mm or more (shorter where allotubes intersect them or a microlamina acutely divides); they appear mainly as thin, dark lines from 0.02 to 0.04 mm across, in a few places showing a line of dark melanospheric dots and in places showing small-scale disruptions in continuity that may represent pores; spacing of microlaminae from 10 to 13 in 2 mm. Allotubes are common in places, showing slightly elongated outlines (circular to subcircular in tangential section), 0.2 to 0.3 mm wide; only a few small, oblique to concave cyst-like dissepiments seen; astrorhizal canals common, usually elongated, vermiform or branching and, typically 0.25 mm in diameter; in addition a few larger, irregularly-shaped, near millimetre-size, gallery spaces occur.

Microstructure of pachysteles is coarsely microreticulate (seemingly orthoreticular), composed of microgalleries, 0.075 to 0.125 mm in diameter; they are typically an association of micropillars that seem to have coalesced into superposed, walled, radially-aligned, tubules, and crossed by microlaminae that seemingly bound tops and bottoms of microgalleries (not possible to determine whether they are micro-beams or floors); nevertheless they are thinner and noticeably less markedly regularly spaced, and imprinted than the microlaminae at tops and bottoms of “interlaminar” spaces.

Remarks. The Broken River species is referred to the genus *Parallelopora* but owing to its indifferent preservation cannot be assigned to a named species. The material was studied previously by C.W. Mallett (1968, p. 225) as part of an unpublished Masters thesis at University of Queensland. Mallett revised Lecompte's species of *Stromatopora laminosa* Lecompte, 1952 (p. 276) from the Givetian of Olloy, Belgium, as a representative of *Parallelopora* based on the differentiation of its fine compact microlaminae and pillars (=pachysteles) with an amalgamated and microreticulated skeletal framework and presence of “pseudozooidal tubes” (=allotubes). Furthermore, Mallett accommodated the Queensland material in Lecompte's species. However, the assignment of *S. laminosa* to *Parallelopora* remains in some doubt; for example, Stearn (1993, p. 222; and see species list in 24-page Supplementary Publication No. SUP 14042 deposited by Stearn in British Library, Boston Spa, Yorkshire, UK) regarded *S. laminosa* as a representative of the genus *Habrostroma*. For instance, the poorly preserved Broken River material does not show the characteristic short pachysteles of *Habrostroma*. In contrast, it does have coarsely microreticulated and extended pachysteles that are diagnostic features of *Parallelopora*.

Little close similarity exists between the Broken River species and other known Australian species of *Parallelopora*. *P. ampla* Webby, Stearn & Zhen, 1993 from the Emsian of

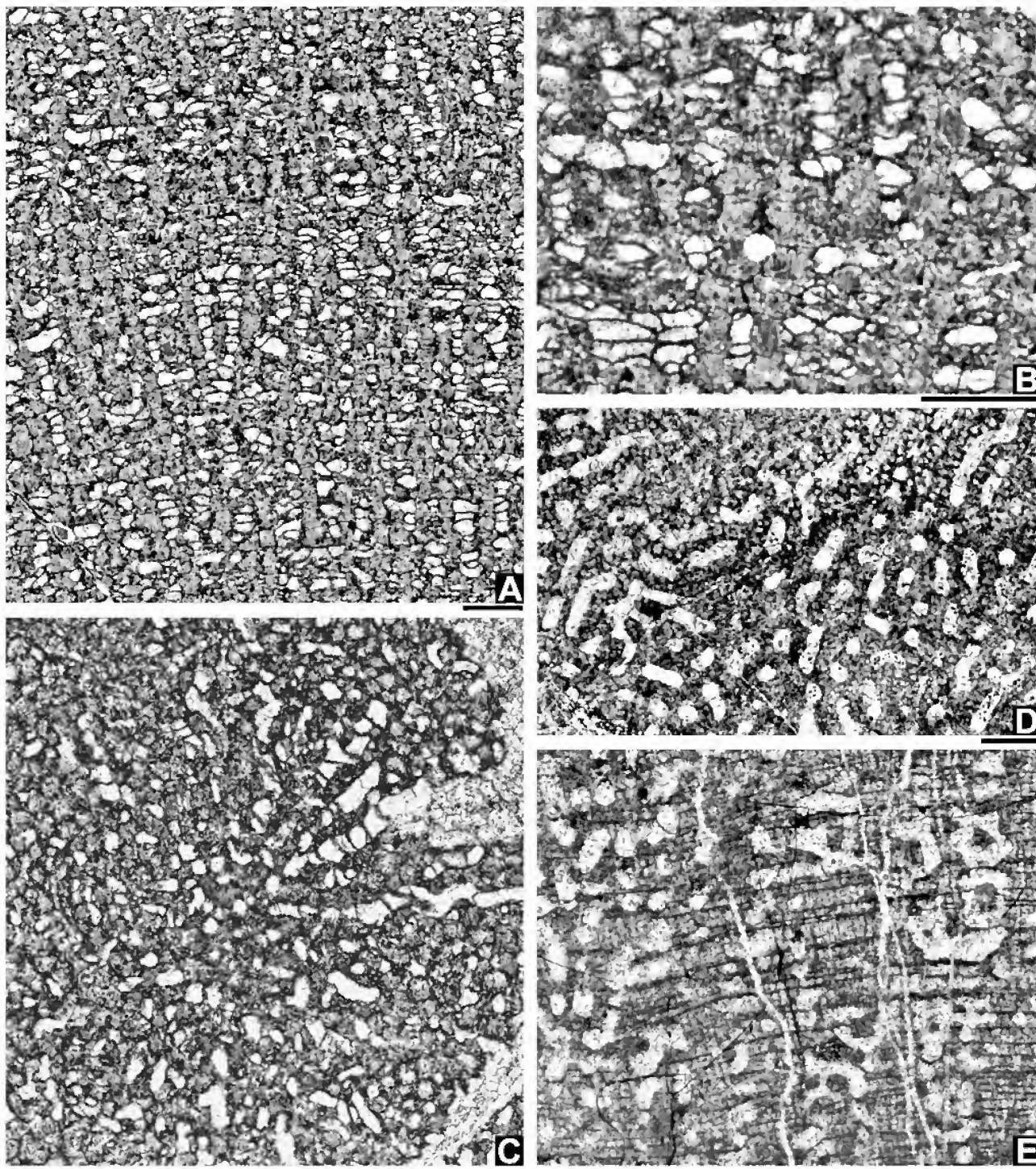


Fig. 7. *Columnnostroma* sp., A–C, specimen AM F.134920, from the Dosey Limestone, 11 m above the base of the SD260 section, NNW of Storm Hill; (A) longitudinal section (AM FT.15152), $\times 10$; (B) longitudinal section (AM FT.15152), showing within much thickened pachysteles small areas where incompletely aligned longitudinal rows of microgalleries and dark melanospheric rows of dots occur, confirming the poorly preserved microreticulation, $\times 20$; (C) tangential section (AM FT.15154), $\times 10$. *Parallelopora* sp., D, E, both specimens come from the same locality at UQL. 2974 of Mallett 1968, as reworked pebbles from Chinaman Creek Limestone along South Chinaman Creek; (D) tangential section of specimen UQF.47979, $\times 10$; (E), longitudinal section of specimen UQF.47983, $\times 10$. Scale bars = 1 mm.

the Murrundal Limestone of Victoria has much thinner pachysteles and only one or two longitudinally aligned rows of microgalleries in each pachystelete. Another species from the Middle Devonian lower Burdekin Formation of the Burdekin Basin (northern Queensland) was reported by Cook (1999, p. 542, fig. 57) as *?Parallelopora* sp. (though

Cook named it also as “*Parallelostroma* sp.” in his caption to figure 57). It shows a closer relationship to the Broken River species with similarly spaced microlaminae, but the pachysteles are comparatively thinner, and astrorhizae do not appear to be present.

ACKNOWLEDGEMENTS. We thank Colin W. Stearn (McGill University, Canada) for his comments on the manuscript, especially in relation to the well-preserved microreticulation, and for permission to quote from parts of his "in press" *Treatise* contributions, especially the syringostromatid section, and also, A.E. (Tony) Cockbain (South Perth, Western Australia) for his constructively helpful review of the manuscript. Additionally, we acknowledge John A. Talent and Ruth Mawson (Macquarie University) for initially inviting us to undertake the study of the Broken River stromatoporoids, and for their efforts in establishing age relationships through the succession, and John S. Jell (University of Queensland) for loan of Clive W. Mallett's University of Queensland stromatoporoid collection.

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